MARCH 1991
VOLUME FOUR NUMBER SIX
SEVEN DOLLARS

CIO

HE MAGAZINE FOR INFORMATION EXECUTIVES

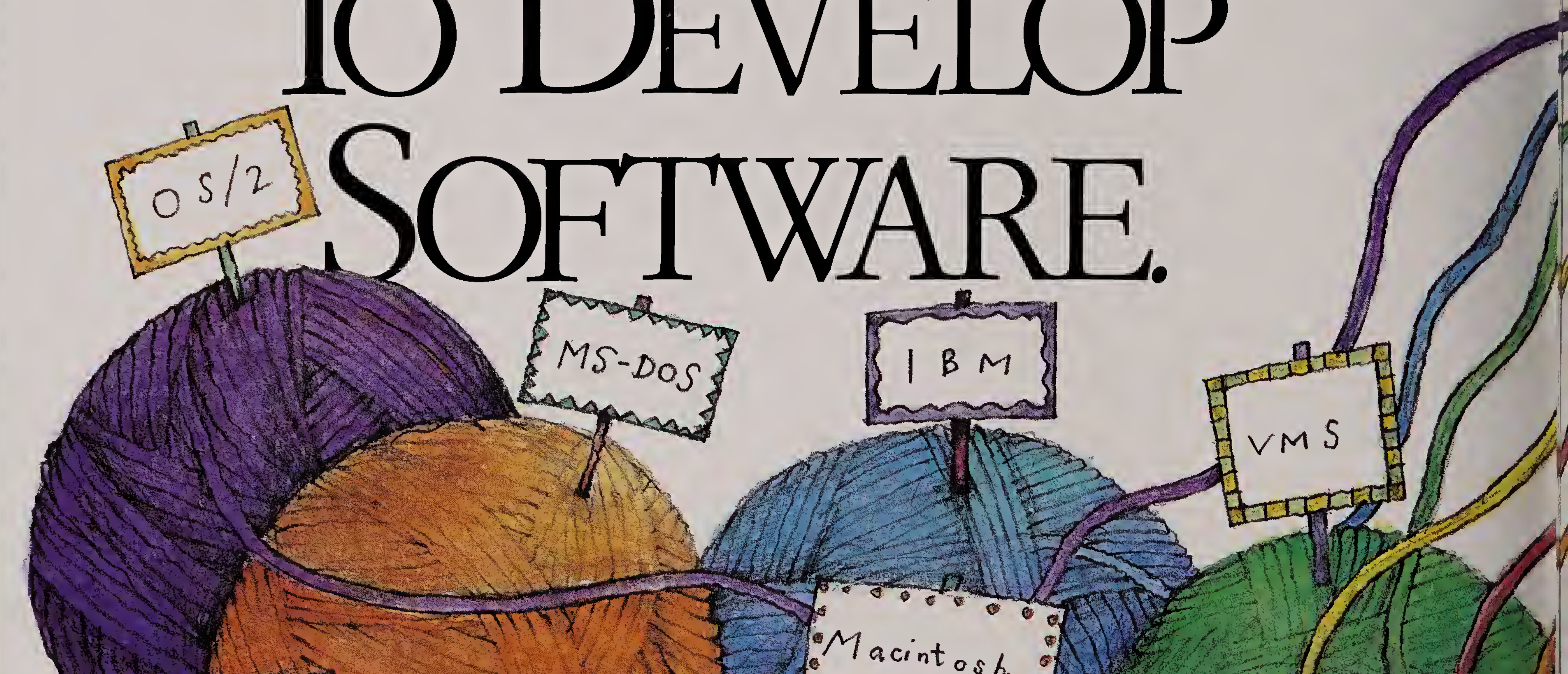
SPECIAL ISSUE:

The Keys To Software Productivity

The JCPenney Co.'s Dave Evans

AN INTERNATIONAL DATA GROUP PUBLICATION

INTRODUCING A BETTER WAY TO DEVELOP SOFTWARE.



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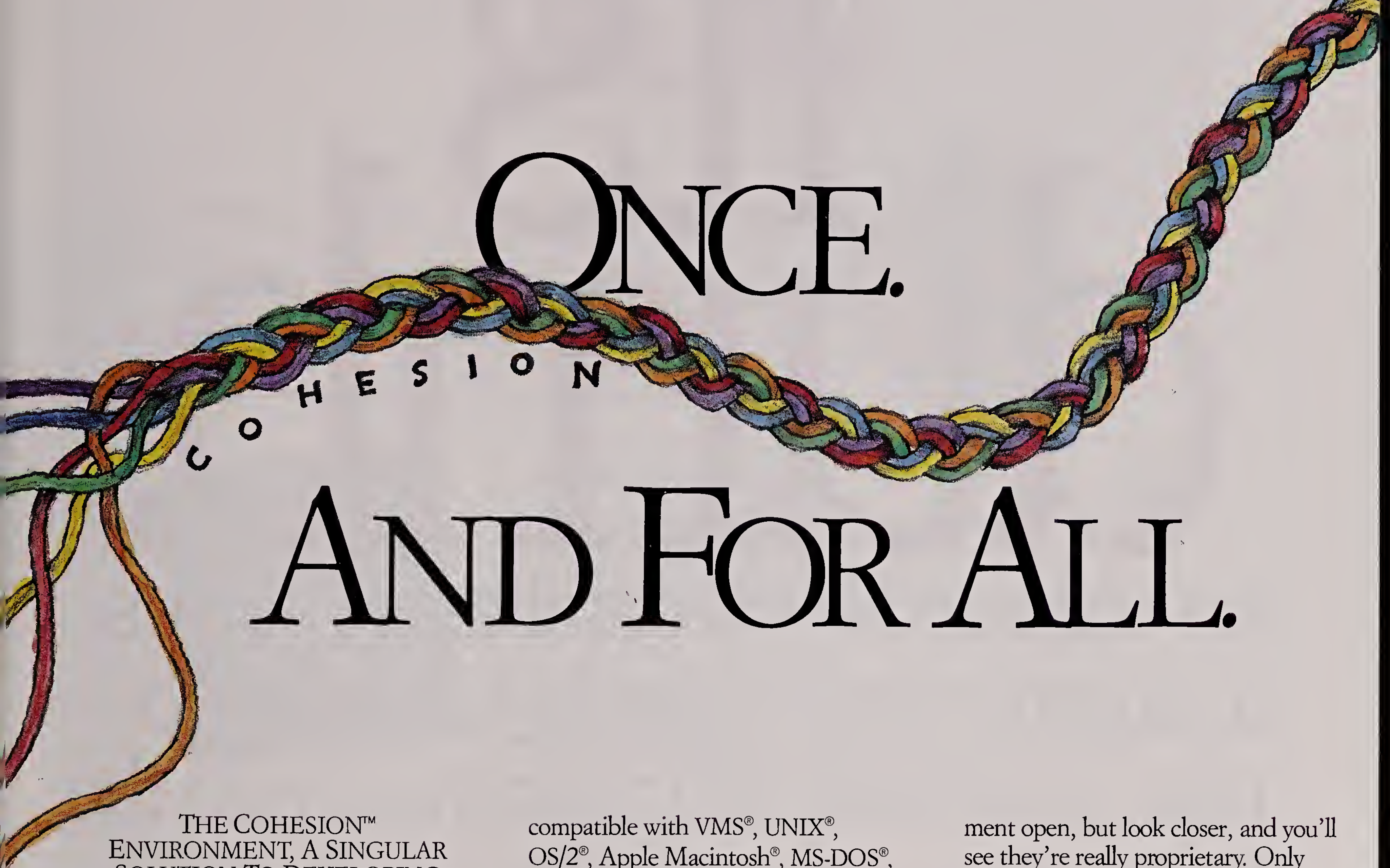

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CIO

VOLUME 4, NUMBER 6

SPECIAL REPORT: SOFTWARE PRODUCTIVITY

Increasing the Yield 23

It's all very well to talk about business excellence, speed and competitive advantage, but every CIO knows that bringing those crops to harvest requires having a lean, mean software development process in place.

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Cover photo by Dan Bryant

Next-Generation Retailing 28

By integrating applications and consolidating databases in a distributed environment, JCPenney is holding the line on software costs and moving toward its vision of a fully automated, cross-functional retail system.

By Meghan O'Leary

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The throttle is open and the boiler is stoked, and the cost of software resources is highballing out of sight. What can the CIO do to keep from being derailed?

By Thomas Kiely

Mastering Methodology 54

New application design and engineering disciplines could bring an end to unwieldy, maintenance-intensive software "contraptions."

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CASE and other tools are solving important pieces of the overall development puzzle, but users still wait for that fabled full-life-cycle solution that does it all.

By David Freedman

Search for the missing links **62**

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Division Head – MIS
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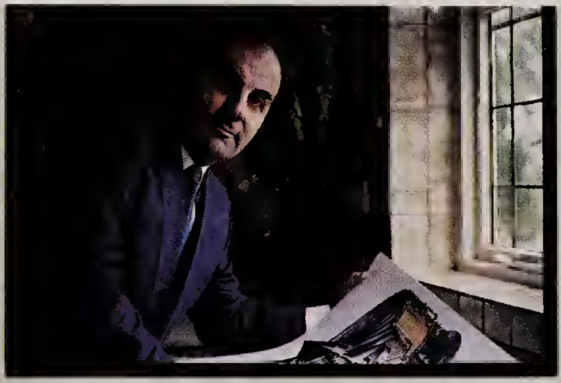

"We are using the IEF to develop a new generation of manufacturing systems replacing over 300 existing systems. We estimate that IEF will increase our productivity by between 2-to-1 and 3-to-1 for new systems development.."

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op information systems with uctivity and maintainability.

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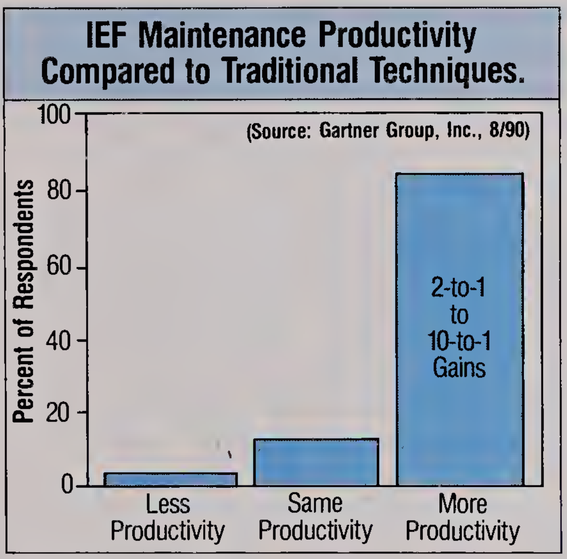
Maintenance productivity gains of up to 10-to-1.

In this same study, developers were asked to compare IEF maintenance productivity with their former methods. Of those responding, *more than 80 percent had experienced gains of from 2-to-1 to 10-to-1.* (See chart.)

Specifications always match the executing application.

With the IEF, application changes are made to diagrams, not code. So, for the life of your system, specifications will always match the executing application. The Gartner Group research showed that *all* IEF users who reported making application changes made *all* changes at the diagram level.



Developers were asked to compare IEF maintenance to former methods. Of those responding, more than 80% reported productivity gains of from 2-to-1 to 10-to-1.

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With our new OS/2 toolset, you can develop mainframe applications, from analysis through automatic code generation, on your PC. Then, using the IEF's TP monitor simulator and the diagram-level testing feature, you can also test these mainframe applications without ever leaving the PC.

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We are committed to standards.

IEF tools and IEF-generated code will comply with standards as they emerge. We will adhere to CUA standards and to the principles of IBM's AD/Cycle and DEC's COHESION—and we will support Open Systems environments centering around UNIX. In any environment, the COBOL, C and SQL we generate adhere closely to ANSI standards. Our presence on standards committees helps us keep abreast of ANSI and ISO developments affecting the CASE world.

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LETTER FROM THE EDITOR

PHOTO BY GEORGE SIMIAN

The old adage, the more things change the more they stay the same, could be used to describe the software dilemma in organizations today. Despite five years of hearing sagas about competitive advantage, IS executives are still locked into a perpetual race to cut the backlog for creating new software applications and to maintain old systems. Three of the top 10 critical issues facing CIOs today are increasing software development productivity, instituting cross-functional systems and improving software quality, according to the Index Group's annual survey of such matters.

Yet are things really staying the same? A slew of new technologies and management techniques promise to eradicate the software treadmill. The frustrating part of this promise is that it requires massive change in modi operandi on the part of CIOs and their information systems corps. Of late the IS group has been taking a lot of heat for being slow to adopt new technology and unresponsive to changing their style of managing software development to meet the needs of business unit clients.

To provide a perspective on strategies for meeting the new systems development challenge, *CIO* this month devotes an entire issue to overcoming the barriers to creating the systems that steer organizations through today's chaotic business environment. Our editorial team and contributors, under the leadership of Special Projects Editor Allan E. Alter, examine escalating software costs and how to tame them, the new thinking on maintenance, the tools that offer the best results and ways to manage new development techniques.

To help us with this task we surveyed more than 100 of our readers to determine their major concerns about, and their solutions to, system problems. Our readers told us that new in-house development is their leading cost concern at a time when many of them have had to cut development staff to curtail costs. They cited fourth generation languages, CASE and prototyping as the tools providing the best productivity. Maintenance to provide new functionality or fix bugs was the leading factor driving up costs, they reported.

The issue is packed with information you will want to keep for reference. Let us know what you think so we can continue to provide you with the perspective you need to bring the software challenge under control.

Marcia Blumenthal

CIO

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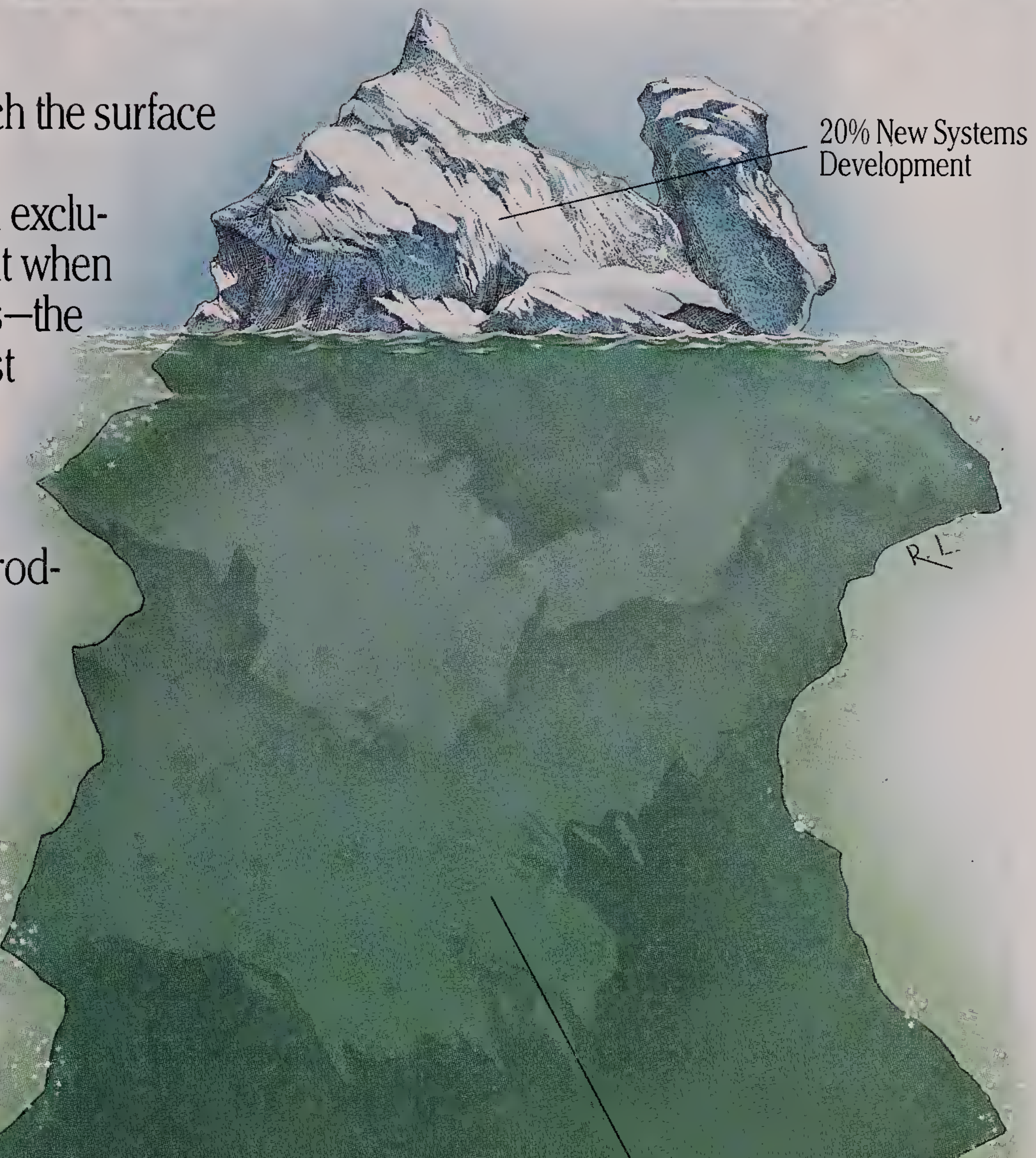
Judging By Other CASE Products, 80% Of Your Workload Doesn't Exist.



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LETTER FROM THE PUBLISHER

> *"In today's high-turbulence environment, business survival requires a steady stream of innovative products or services. Creativity requires a kind of corporate glasnost--an openness to imagination, a tolerance for deviance, for individuality, and the serendipity that has historically accounted for many creative discoveries. . . ."*
>
> *Alvin Toffler*
> Powershift

PHOTO BY GEORGE SIMIAN

The role of the CIO as enabler is a confusing one, riddled with contradiction and conflict. The CIO must control information, consigning it to its valid users while securing it from unlawful ones. Concurrently, he or she must establish an environment that encourages invention and inspiration.

How to do this with viruses potentially lurking in every program, users demanding ever more access to databases, and management demanding to see the measurements of increased profits from its information resource expenditures?

Obviously there is no facile answer (there wouldn't be a need for *CIO* if there were). The most successful CIOs appear to have a background in business practice, a solid understanding of their companies' products and services, knowledge of IT concepts, a sensitivity to the different types of personalities and objectives that constitute their domain, leadership skills and, above all, a sense of humor if not of irony.

What fascinates me is that if you listed these attributes without identifying their holder, most people would assume you were talking about the CEO.

In just a few days, at Amelia Island Plantation in Florida, the CIOs of companies of all sizes will meet with practitioners and professionals from a variety of industries and disciplines to discuss these very topics. The best discovery is the one about to be made, and we hope to help CIOs detect the best ones for their companies.

P.S. For those of you who can't join us at Amelia Island, the next CIO Perspectives conference, "IT and the Corporate Agenda: People, Productivity and Profits," will be held Sept. 22-25, 1991, at the Hyatt Regency in Monterey, Calif. For jazz aficionados, this coincides with the last day of the Monterey Jazz Festival.

Coming In CIO

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The Greening of the Bottom Line

Faced with the prospect of lawsuits and heavy fines, businesses are realizing that the free and effective flow of information is a key tool for managing toxic substances. IT may turn out to be the greenest solution of all.

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Cooperative Processing

If your mainframes or minis are linked to PCs, you're probably spending more time, money and processing power than you need to and getting less integration and ease of use than you should. Cooperative processing can change all that.

· · · · · · · · · · · · · · · · · · · ·

The Conundrum of the IS Mission

IS is supposed to give users what they want, yet many users do not themselves know (or cannot articulate) what that is. Worse, users may *think* they know what can help without understanding the limitations of the technologies involved. Is there a way to solve this problem?

· · · · · · · · · · · · · · · · · · · ·

Getting Costs Under Control

Comparative analysis is a way of evaluating a company's costs in relation to those of its business and technology peers.

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EVALUATING PACKAGED SOFTWARE

HOW BEST TO KICK THE TIRES

Consumer Reports is no help. You can't ask the lady at the bus stop where she got hers. Even taking it out for a spin around the block is hardly sufficient.

Software evaluators must rely on their own methodology when selecting a packaged system for their companies. Unfortunately, many such methodologies are imprecise and ineffective, according to David A. Schmaltz, supervisor of applications development for Standard Insurance Co. in Portland, Ore. Writing in last August's *Journal of Systems Management*, Schmaltz faulted evaluators for approaching their task without clearly defined objectives and presented his own guidelines for effective software selection.

Identify Goals: You can go into a car dealership demanding AM/FM radio, air conditioning and cruise control, but if you don't know at the outset whether you want a Buick or a Ferrari you may be shopping for a long time. Similarly, software evaluators must identify their companies' most important goals to simplify the search.

Emphasize Facts: Evaluators should concentrate on what is known about the software rather than attempt a "wholesale quantification of all requirements."

Don't Guess: Evaluating software is no true-or-false test where you have a reasonable chance of getting the right answer no matter what you put down. If you can't assess a component, assess the impact of not having it; don't substitute a "probably" in order to be thorough.

Limit Criteria: Funding authorities may expect lengthy evaluations, but there's no need to waste time on insignificant factors.

Schmaltz also offered some myths that get in the way of effective selection:

Myth No. 1: Detail is the key to precision. Burying yourself in detail won't make the evaluation more accurate; choose evaluation points with rigor.

Myth No. 2: Numbers are the best measure. Sometimes impressions are the most accurate source you have.

Myth No. 3: All requirements must be assessed. Not unless they're all of equal importance. Effective evaluators work with the minimum set of comparisons. ▬

BUILDING THE BETTER METRIC

Software costs per man-month range from $3,000 (at smaller companies or in less expensive regions like Nebraska and North Dakota) to $12,500 (at defense contractors or in affluent regions), according to Software Productivity Research Inc., a CASE vendor and consulting company in Burlington, Mass. This makes it difficult to compare software productivity among industries, companies or even some business units.

To make comparisons easier, SPR advocates a synthetic metric, like the Dow Jones average, called a function point. Devised by IBM, function points are a weighted combination of factors such as input, output, inquiries and so on. SPR estimates that in small projects—say a 20-function-point project involving about 2,000 lines of Cobol source code—the majority of the effort is devoted to coding (61 percent); less goes to the removal of defects (18 percent), management and support (11 percent) and paperwork (10 percent). But defect removal and paperwork claim an increasingly greater portion of the effort as the project size increases, while management and support figures rise at rates proportional to the function points. In a megaproject—one involving over 40,000 function points, say—SPR estimates that only 12 percent of the effort is devoted to coding, whereas 33 percent goes to paperwork and 37 percent to defect removal. Management and support account for 18 percent. ▬

INDUSTRY OUTLOOK

HARD TIMES? WHAT HARD TIMES?

Recession? Phooey! Software products are helping to fuel double-digit revenue growth in information services, according to INPUT, a Mountain View, Calif., market research firm. In its 1990 annual survey of the systems software market, INPUT concludes that the $90 billion U.S. market for information services—including processing and networking services, systems integration, professional services, software products and turnkey systems—will grow at an annual compound rate of 13 percent through 1995. But software products alone will account for an increasingly larger portion of that market, perhaps claiming 35 percent of all user expenditures for IS by mid-decade.

INPUT estimates that in 1990 customers spent $16.4 billion—about one out of every two software dollars—on systems products, including operations management tools, application development tools and systems control packages. By 1995 that figure should grow to $31.5 billion, at a compound annual growth rate of 14 percent.

Among systems software products, the greatest growth will be in the PC and workstation slice of the market (24 percent); there will be more

TRENDLINES

modest growth in markets for minicomputer and mainframe wares (11 percent each). In dollar figures, that could mean that PC systems software will grow from a $3.1 billion market today to a $9.3 billion market in 1995, while the market for packages aimed at mid-range machines will grow from $5.5 billion to $9.2 billion, and the market for big-machine systems software will grow from $7.8 billion to $13 billion.

Operations management tools, such as network administration and control products, should grow from a current $3.7 billion market to a $7.7 billion market by mid-decade, as customers increasingly try to milk the most from their multiplatform, multivendor networks. Systems control products, such as emulators, spoolers and network controllers, should help networkers too. Increasingly these products will support standards and run on both new and existing hardware, INPUT said. The firm predicts that systems control software will be an $11.6 billion business in 1995, up from $6.2 billion today.

At the same time, applications tools, such as CASE products and 4GLs, will become increasingly de rigueur in IS shops, propelling the market from its current $6.5 billion level to $12.2 billion, with the greatest increase in CASE products.

THE CODE HARD FACTS

In the April 1990 issue of *System Development*, consultant Carma McClure shed some light on how much software is out there. According to McClure the business community relies on 100 billion lines of code, which cost several trillion dollars to develop. Maintenance alone accounts for $30 billion a year and 80 percent of the software work now being done. McClure also cited a study showing that the three most expensive software errors cost all the companies where they occurred a total of $1.6 billion, $900 million and $245 million respectively. All three were maintenance errors—and each was the result of changing a single line of code.

The private sector is not the only one swimming in a sea of code. McClure said that the U.S. Air Force spent $25 million on software just for the F-16 fighter plane. She estimates that if maintenance requirements continue to grow at the current rate, a quarter of the population between ages 18 and 25 will be needed to maintain software into the wild blue yonder by the year 2000.

Help Facilities

• • • • • • • • • • •

Selected Support Resources

CASE Studies Consortium
Washington University, St. Louis 314 889-5330
This consortium explores approaches and implements advanced application development and maintenance technology. Education and training is a major focus of the group, which provides seminars, management presentations, assessments, research reports and events.

Software Maintenance Association
Vallejo, Calif. 707 643-4423
SMA is a professional membership organization designed to aid the advancement of software maintainers. It sponsors conferences, technical workshops and three annual awards.

Association for Systems Management
Cleveland 216 243-6900
ASM offers education and training programs on JAD, CASE and software quality assurance and testing. Membership advantages include hardware and software discounts, bimonthly newsletters, ASM career services and ASM recognition and awards.

Development Center Institute
Indianapolis 317 846-2753
This not-for-profit corporation focuses on sharing information on software tools and IS procedures. Membership includes sponsored conferences with discussions on experiences in acquisition, software package usage, productivity planning and improving systems quality.

International CASE Users Group
San Ramon, Calif. 415 842-6703
ICUG obtains its support from local chapters of CASE Users Groups in major cities worldwide. It formulates speakers lists, publishes a newsletter and sponsors national conferences.

Software Productivity Consortium
Herndon, Va. 703 742-7157
This consortium was founded in 1985 to develop processes, methods, tools and services aimed at improving the design and implementation of mission-critical software systems. A new focus for technical programs, including future software engineering methods and tools, was recently adopted.

ON AVERAGE

According to the Index Summit's 1990 Survey of Systems Development Directors, the average systems development department employed 172 personnel (with development teams of 8.4 members each), worked on a total of 33 development projects and maintained 370 applications. A majority (65 percent) used a standard systems development methodology, while slightly fewer (59 percent) used an automated project management system. The average development budget for new applications was $12 million, and the average maintenance budget was $9.6 million.

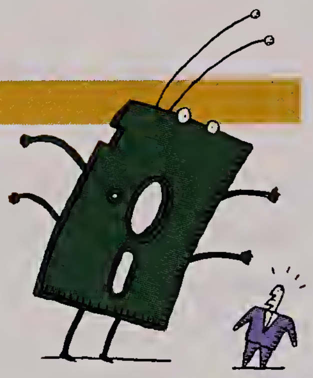
The survey was conducted by a service of the Index Group Inc. in Cambridge, Mass. It polled 95 systems development directors from a variety of industries with average revenues of $6.1 billion.

ILLUSTRATIONS BY JAMES KACZMAN

TRENDLINES

SOFTWARE TESTING

BUGS BEGIN AT CONCEPTION



Developers don't usually create software defects when they write their applications; defects usually creep in much earlier, through incomplete, inaccurate or ambiguous design specifications. That's the conclusion drawn from a survey of developers conducted by Beth Layman, director of research for the Quality Assurance Institute (QAI) of Orlando, Fla. "[Developers] do not seem to have a handle on how to get good, valid and verifiable requirements," she said. "That's just not happening right now."

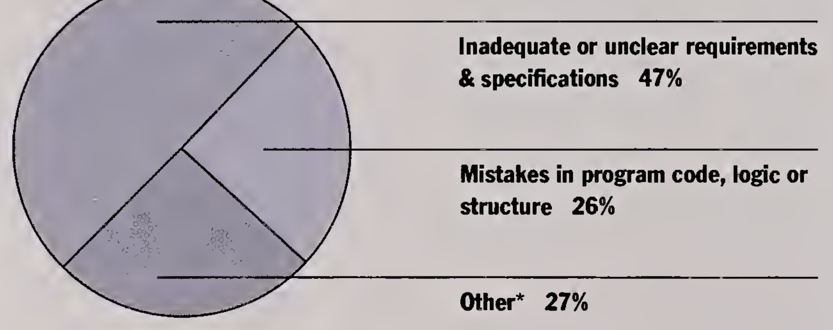
Layman's data came from a questionnaire distributed at last fall's QAI Conference on Software Testing. Nearly half of the attendees cited poor conceptual foundations as the single biggest cause of later difficulty. One quarter pointed to coding or similar building errors, while the balance scattered their responses fairly evenly among five smaller categories. Ironically, the same group of developers said that the vast bulk of their testing efforts didn't begin until the code was laid down; in fact, they admitted that a significant portion didn't begin until the application was actually installed.

Delays in identifying defects make for more costly and cumbersome repairs, according to Layman, but too many managers seem wedded to the outmoded idea that quality control comes at the end of the cycle.

"Testing only when there is code gives them something to pound on the keyboard with; it's fairly black and white," she said. "Trying to detect errors [in the system's specifications or assumptions] just doesn't yield the same clear results."

Layman's surveys of developers suggest that speed often wins out in the contest with accuracy. She has found consistently that some 40 percent stopped testing at the delivery deadline, whether or not they had performed all their planned metrics. Layman also found that substantial majorities do not keep track of how they apportion their time among testing, development and maintenance activities; that few companies measure the effectiveness of their testing efforts and that even fewer provide specialized training for their software testers.

MAJOR SOFTWARE DEFECTS

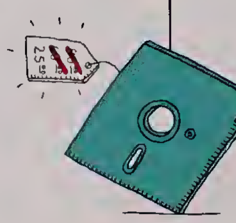


* Includes inability to process errors properly, failure to meet user needs as completed, failure to conform to all shop standards and bad repairs (5 percent each), failure to interact correctly with other applications (7 percent).

SOURCE: QUALITY ASSURANCE INSTITUTE'S 1990 SURVEY

AND THEY'LL THROW IN A SECOND PAIR OF PANTS

When shopping for software products and services, haggling can pay off—possibly to the tune of some pretty hefty dough. The November 1990 issue of *The Software Strategy Report,* published by Forrester Research Inc. of Cambridge, Mass., reported an incident involving a major insurance company that was interested in buying Texas Instruments Inc.'s Information Engineering Facility (IEF) suite of CASE tools. The particular configuration carried an initial $20 million price tag which, following a few bargaining sessions, was slashed to a paltry $5 million. Apparently the first price quoted was based on standard discount schedules, but this was a "special deal." For the insurance company it turned out to be a very special deal indeed, because IE consulting group James Martin Associates agreed to knock down its fee on the same project from $225 per hour to only $200 per hour.



This deal sure beats double coupons.

MOM, I'M GOING INTO SOFTWARE

Two different research efforts, one on each coast, arrived at similar estimates for software expenditures in U.S. corporations. *Computer Economics,* a magazine published in Carlsbad, Calif., estimates that companies spent 6.82 percent of their IS budgets on software in 1988. In 1989 that figure increased to 9.06 percent, and in 1990 it increased again to 10.6 percent. On the East Coast, the Framingham, Mass., market-research firm IDC estimates that the figure was about 9 percent in 1990 and will escalate at a rate of 2 percent per year. IDC estimates that between 45 percent and 48 percent of the IS budget goes to human resources.

CRITICAL ISSUES

THAT 'TECHIE' RAP

A recent survey by Index Summit, a service of the Index Group of Cambridge, Mass., indicates that the five most critical issues facing systems development managers today are developing an information architecture, achieving support for cross-functional systems, identifying and developing strategic systems, developing systems more rapidly and increasing developer productivity. The survey of 95 systems development directors in North America examined changing corporate IT re-

TRENDLINES

quirements and explored technical as well as organizational barriers to effective systems development.

While 98 percent of respondents agreed that the systems development function must be business-oriented and cross-functional, the majority indicated that functional managers are unwilling to assign people to development project teams (67 percent) or to share data for projects (64 percent). Seventy percent felt that functional managers viewed them as technicians rather than businesspeople.

The image problem, according to the report, stems in part from a traditional programmer/analyst career path, which isolates technicians from positions in functional units. In addition, systems development is in the midst of transformation from a mainframe-oriented culture emphasizing procedural language, hierarchical data structures and centralized computing, to a PC and workstation-oriented culture marked by prototyping, joint application design and development productivity tools.

Only 20 percent of respondents thought that their current development methods were up to the task of designing and building strategic systems. A majority felt that tools could significantly increase their development productivity; in general, respondents were interested in CASE tools, but they had questions regarding their power, applicability and efficacy. An overwhelming 94 percent of those surveyed suggested instead that the greatest productivity gains lie in improvements to the requirements analysis stage of development. Most cited other problems—such as estimating and managing project time and costs, and the difficulty of measuring the value of development methods—as additional barriers to productivity.

Human-resource issues surrounding systems development are also becoming more complex, as indicated by respondents who said their staffs needed better training in requirements analysis and business problem-solving. Systems development managers who wish to improve their lot, the report concludes, "must concentrate on changing these perceptions [of developers as techies], re-engineer current practices within systems development and exercise inspired leadership within the firm." ■

DAD, I'M GOING INTO MARKET RESEARCH

Ever wonder how accurate market predictions are? Norman Weizer, a consultant at Arthur D. Little Inc., of Cambridge, Mass., has predicted that the U.S. market for software and services will be $86 billion to $94 billion in 1992, and $149 billion to $163 billion in 1997. These estimates are based upon work he published in 1988 in *Spectrum,* a publication of Decision Resource, an ADL spin-off. At the time, Weizer used 1987 figures ($46.8 billion) as his starting point. Early in 1991, Weizer could happily report that his estimates were right on track. ■

Required Reading

Books, articles and other publications on software-productivity issues

BOOKS

The Mythical Man-Month: Essays on Software Engineering
By Frederick P. Brooks Jr.
Addison-Wesley Publishing Co. (Reading, Mass.), 1974

CASE Is Software Automation
By Carma McClure
Prentice-Hall (Englewood Cliffs, N.J.), 1989

Making Software Engineering Happen: A Guide for Instituting the Technology
By Roger S. Pressman
Prentice-Hall (Englewood Cliffs, N.J.), 1989

Software Quality Engineering: A Total Technical and Management Approach
By Michael S. Deutsch and Ronald Willis
Prentice-Hall (Englewood Cliffs, N.J.), 1988

Creating Effective Software
By David King
Prentice-Hall (Englewood Cliffs, N.J.), 1988

Managing the Software Process
By Watts S. Humphrey
Addison-Wesley Publishing Co. (Reading, Mass.), 1989

ARTICLES

"A Framework for Information Systems Architecture"
By John Zachman
IBM Systems Journal, Volume 26, No. 3, 1987

"Timebox Methodology"
By James Martin
System Builder Magazine, April/May 1990

"The Realities of CASE"
By Kathryn J. Hayley and H. Thaine Lyman
Journal of Information Systems Management, Volume 7, No. 3, Summer 1990

"CASE Tools in a JAD Workshop"
By Peter F. Brennan
CASE Trends Magazine, March/April 1990

MAGAZINES

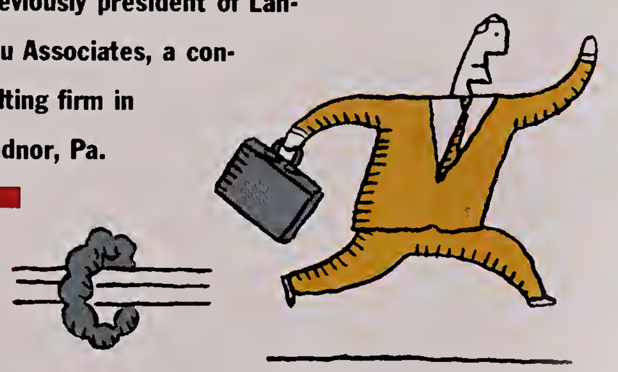
System Builder—The Manager's Guide for Application Development
International Computer Programs Inc., Indianapolis

System Development, a monthly newsletter on improving software productivity; Applied Computer Research Inc., Phoenix

CAREER MOVES

Grumman Corp. has tapped its top information systems executive—Grumman Data Systems Division President ROBERT J. MYERS—to be the new president and chief operating officer of the parent company. Myers' replacement as head of the Bethpage, N.Y., firm's IS unit is GERALD H. SANDLER, previously senior vice president of IS.

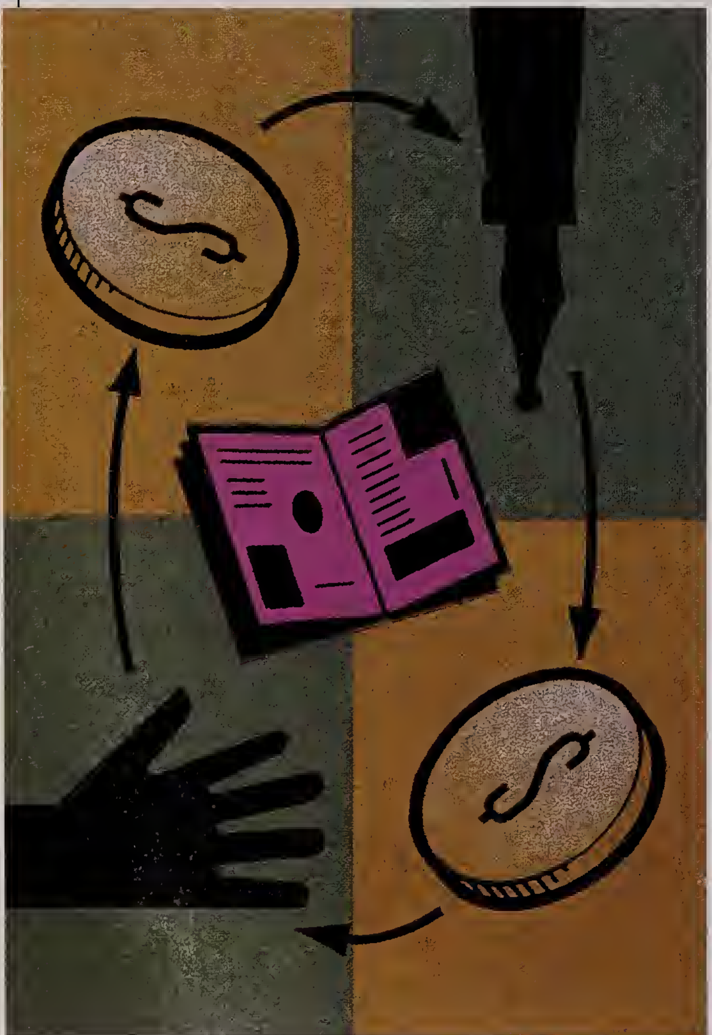
JEFFREY I. LANDAU has been appointed to the position of vice president of MIS and chief information officer at Nutri/System Inc. in Blue Bell, Pa. Landau was previously president of Landau Associates, a consulting firm in Radnor, Pa. ■



Low-Cost Manual Labor

Providing good documentation for proprietary applications can chop support costs and increase productivity—and it need not be prohibitively expensive

BY BOB MORSE



Most CIOs recognize the value of good software user documentation and are grateful for the comprehensive, slickly produced user manuals that now accompany most broad-market commercial products, often with tutorials that help to jump-start new users. Good manuals help users learn and understand their software tools, but they also help to reduce user frustration and can dramatically reduce the demand for support services.

Commercial-software vendors can easily accommodate the expense of producing good manuals by simply distributing the costs over their products' many users. But how can a CIO justify the expense of good documentation for a proprietary application (created specifically for an organization's unique needs) with a limited user base? The savings in post-installation support costs can be persuasive, since support is particularly expensive for proprietary applications—whether or not they are developed by in-house IS resources. And of course, the other benefits of good manuals contribute directly to increased productivity. But many CIOs have to wonder whether, in the end, these benefits are really worth the cost.

For many CIOs, the case for providing good documentation falls apart right there, since good manuals are commonly assumed to cost more than their value to an organization. But good manuals need not be prohibitively expensive, especially if the right people are chosen to produce them.

Many organizations would save money by farming out their documentation work to independent specialists, but those who do choose to keep the process in-house would do well to assign these projects to their marketing or corporate-communications people. In general, the text and organization of a manual will be more user-friendly—and hence, more useful—if it is developed by a writer with some technical aptitude, rather than by a technical person with some writing skills. Even programmers who are wizards at systems development usually are not as adept at crafting user-friendly outlines, sentences and paragraphs. Of course, some programmers are also blessed with good writing skills, but even these talented souls are hard-pressed to step far enough back from their work to approach it as first-time users—an essential perspective for a software technical writer. Documentation produced by programmers tends to be riddled with jargon and invalid assumptions, and these flaws can cripple the effectiveness of an otherwise beautifully written manual.

The choice of personnel for developing user documentation can thus profoundly affect the benefit side of the cost-benefit equation, since a well-organized and -written manual will yield more of the intended benefits than an inadequate manual. But the cost side of the equation can be manipulated too, by applying a few economizing strategies.

First and foremost, the author of a proprietary-software user manual should keep in mind that the needs of his or her audience are different from those of the users of commercial-software products. Commercial-software manuals must serve double duty as both a training tool for new users and a reference for old hands. But users of proprietary applications are usually already familiar with the

ILLUSTRATION BY BOB HAMBLY

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tasks that their applications will facilitate, and they almost always have access to in-house training resources in the form of experienced coworkers, supervisors and IS staff. The manuals for most proprietary applications, therefore, need serve only the reference function.

Task-oriented operating instructions—recommended for all documentation in any case—incorporate the tutorial function by nature, but within any feature-specific subsection the text need not be as explicit for proprietary applications. Features may be described generally, rather than in long, convoluted, numbered-step sequences with procedural forks and loops. Many features, for example, may be adequately described simply by listing and defining only those field names that the typical user is unlikely to understand intuitively. A few supplemental notes may be helpful—to explain, for example, the significance of any particularly important field values. But in any event, a separate section of learning exercises can be omitted altogether.

By omitting the tutorial function, the author can shorten both the page count and the time required to produce the manual. Additional time and cost savings can be realized with the understanding that, for essentially the same reasons, proprietary-software documentation need not be aimed at a "lowest-common-denominator" user—an orientation that the authors of commercial-software manuals are obliged to respect.

Another nonessential element that often can be eliminated is the index. Even with the help of many word processors' so-called automatic indexing features, the development of a truly meaningful index is time-consuming work. If the author can create a sufficiently detailed table of contents with at least three levels of sections and subsections, and if the section/subsection titles are as descriptive as possible, in most cases an index will be unnecessary.

All software—proprietary and commercial alike—can be documented much more efficiently by the application of "the distributive property of documentation." Assuming the software itself employs a standard user interface to its features, the documentation can be organized "algebraically"—whatever information applies to a set of two or more features or functions can be "factored out" into introductory sections, so that it need not be restated throughout the manual.

> *By omitting the tutorial function, the author can shorten both the page count and the time required to produce the manual.*

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tive—example of this principle is an element that no manual for a multifeatured application should be without: an introductory section titled "System Basics and Conventions." In this section, the author can describe, generally, the "look and feel" of the application: its user interface; menu types (numbered lists versus highlight bars versus "Lotus-style"); the types and manifestations of prompts; cursor controls; basic text-entry/editing features; and any systemwide consistent keystrokes. The author's efforts in the "how-to" sections can then be devoted to documenting the substance of each individual feature.

A "System Basics and Conventions" section contributes an added advantage in proprietary-software documentation, since it can orient new users to the system. The recommendation that authors abandon tutorial sections to cut costs does not mean that a manual can't benefit from another economizing strategy that incidentally restores some of the tutorial function. "System Basics and Conventions" can gently introduce new users to the system in order to familiarize them with basic operating principles without the distracting encumbrance of specific "how-to" feature instructions.

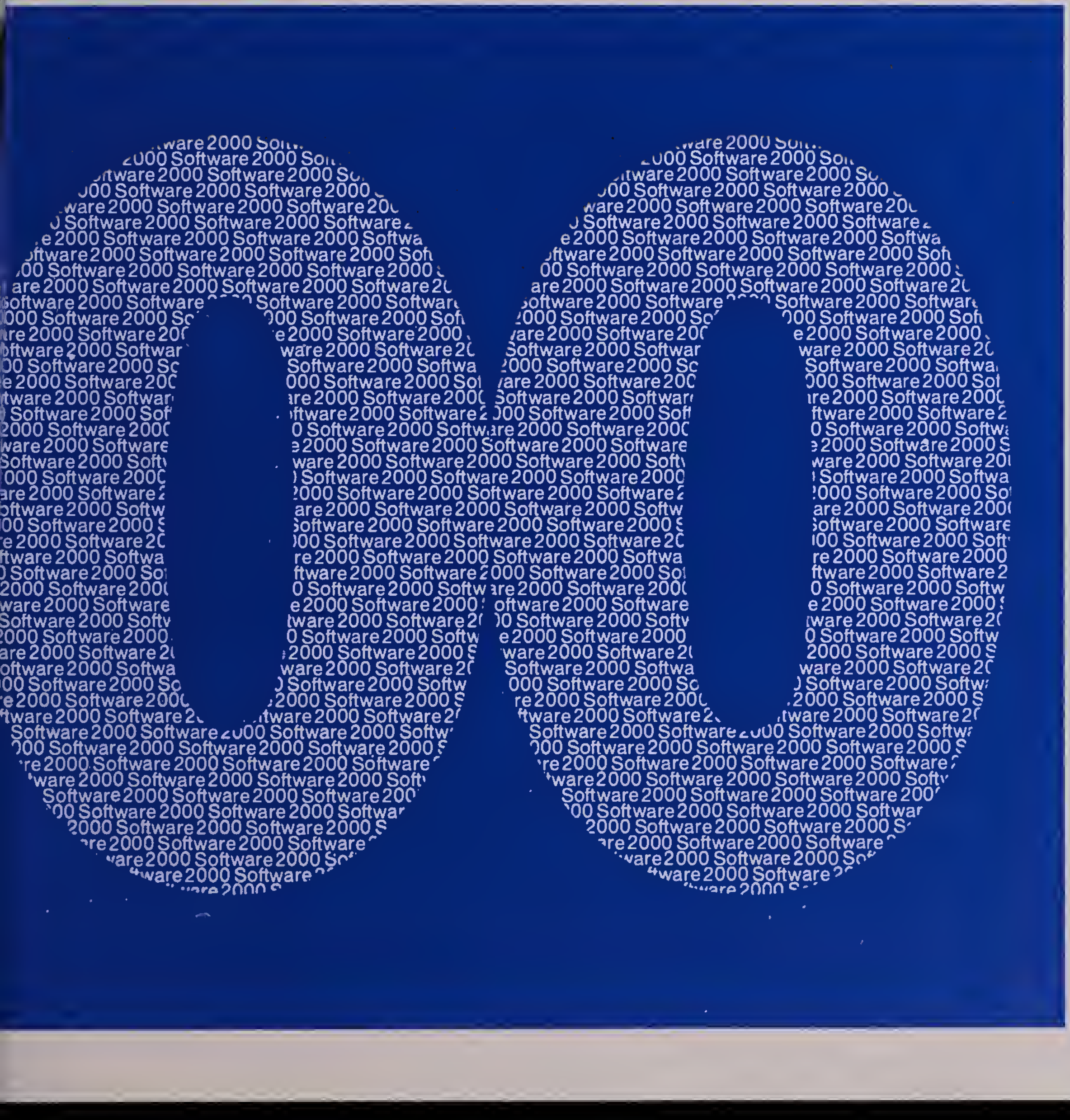
This factoring out of common information can also be applied to documenting report-printing features, since the generic procedure often is consistent for all reports within an application. The author can explain the procedure once, for all reports, using variables to denote any report parameters (date ranges, subject IDs, sort/select criteria) that vary from one report to the next. Individual reports may then be documented by explaining in a sentence or two what each contains.

Finally, many CIOs could save their organizations a few dollars by farming out documentation projects to outside specialists. Many freelance writers and editorial service bureaus specialize in technical writing, and some even specialize in software documentation. An organization's programmers may enjoy documenting their own work (most don't) and actually be good at it. But an independent specialist usually can develop a manual faster and at a per-hour fee that is significantly less than the return the organization could realize from a programmer's time applied to his or her own specialty. A CIO's local yellow pages (under "Technical Manual Preparation," "Editorial Services" and "Writers") might yield a list of candidates with suitable specialties.

The case for providing good user documentation for proprietary applications grows stronger with the understanding that the cost-benefit equation can be manipulated at both ends. The right perspective can increase the benefits, while the right methods can decrease costs. The right writer can achieve both. CIO

Bob Morse is the owner of Morse Editorial Services in Mount Horeb, Wis., a contract technical-writing service specializing in software documentation.

he Clearer The Answer Becomes.



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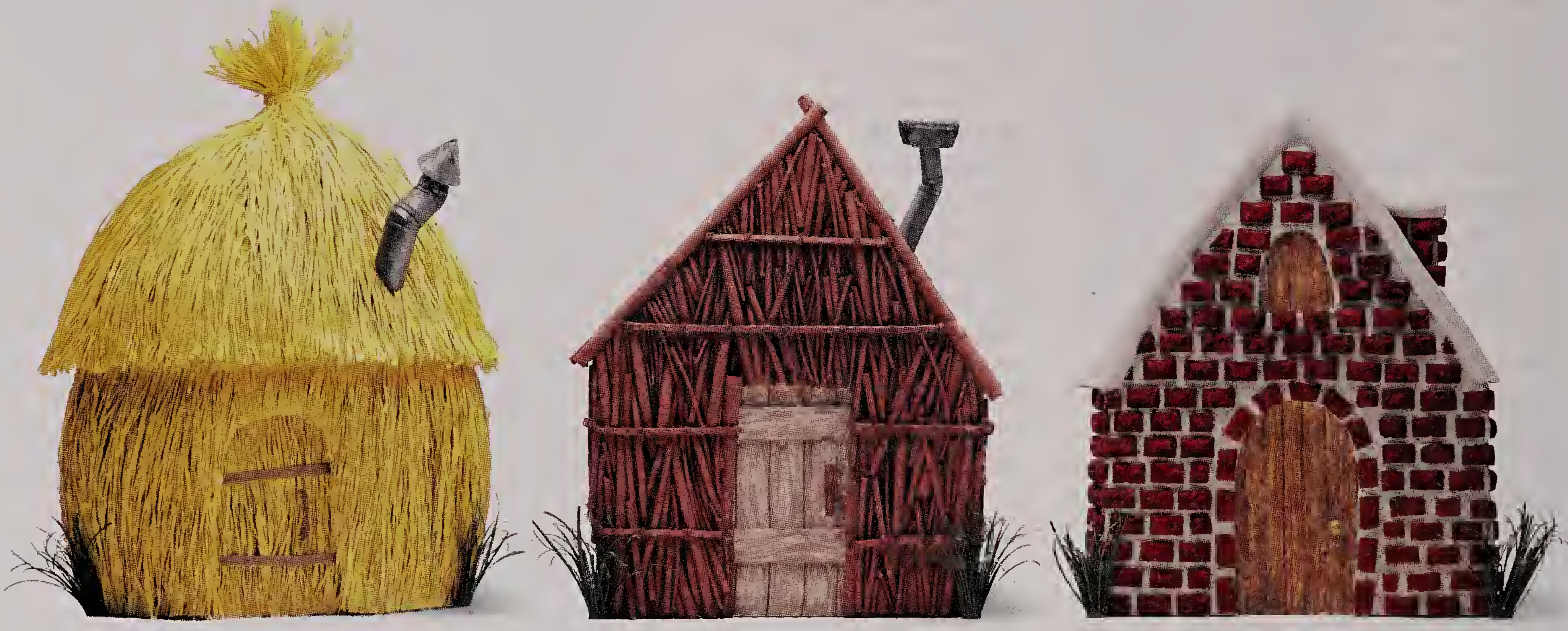

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Increasing the Yield

It's all very well to talk about business excellence, speed and competitive advantage, but every CIO knows that bringing those crops to harvest requires having a lean, mean software development process in place

Business issues crowd today's IS agenda: re-engineering business processes, attaining competitive advantage, aligning IS with corporate goals. Yet one of the oldest, most basic chores in computing remains a top issue for CIOs: developing software. IS organizations are still casting about for better ways to develop, buy and customize high-quality software in less time and for less money. Creating systems is like playing sports—you can't win unless you can execute the fundamentals better than the opposition. CIOs who cannot make their software development efforts more productive may find they are tilting at windmills instead of achieving their business agendas.

Boosting software development productivity was cited as one of IS executives' top concerns in the Index Group's 1991 survey of critical IS management issues (see Trendlines, Page 16). Conversations we've held with CIOs reveal why. The costs of developing and maintaining software and of obtaining licenses from software vendors are extremely high. The lack of congruence between software development and companies' most pressing business needs, large development backlogs, the limitations of current software development tools, and a lack of support from senior management are considered barriers to software productivity.

Organizational culture issues are important, too. "Achieving software productivity is not a linear process," said Robin N. Barrett, a J.P. Morgan vice president in New York; "it's not just a matter of give us tools and the job is done. It involves a lot of sociological and organizational issues that need to be addressed. We need to change the culture and the mind-set of the players in the game."

In this close-up look at software issues, *CIO*'s writers examine how IS executives are overcoming the barriers to software productivity. Tom Kiely explains why software costs are going up and what CIOs can do to keep the impact to a minimum. Dave Freedman looks at how CIOs are putting the current generation of development tools to work and peeks ahead at what's around the corner. Software maintenance is a major burden on IS budgets; Kathy Melymuka's article shows how IS departments are minimizing this necessary expense. And Mickey Williamson brings readers up to date on the most effective development methods in use today, from joint application design sessions to prototyping.

> **"Achieving software productivity involves a lot of sociological and organizational issues that need to be addressed. We need to change the culture and the mind-set of the players."**
>
> *–Robin N. Barrett*

But improving software productivity is not just a matter of tools, techniques and cost calculations. CIOs must convince their own IS staffs to embrace these new methods and persuade users and other beneficiaries to support them and become involved. Mickey Williamson takes a swing at showing how CIOs are overcoming resistance, ignorance and apathy.

Instituting cross-functional systems was one of the few issues that scored higher than software productivity on the Index Group survey. To illustrate how one organization is overcoming the barriers to software productivity, we chose a company that is in the midst of building such a system. Meghan O'Leary flew to Dallas to examine how JCPenney is solving the software development riddle as it links its executives, buyers, store managers and suppliers.

That's not all. Peter Keen explores why there's more to graphical user interfaces than meets the eye and Bob Morse offers suggestions for producing software documentation on the cheap. Finally, this month's Trendlines pages are chock full of recent studies, findings, statistics and surveys related to the general software theme.

All in all, we hope this special issue will not just shed light on the state of the art in software development but help CIOs light some fires too. CIO

—A. Alter

First *CIO* Software Productivity Survey

To give readers even more insight into CIOs' concerns over software productivity, we conducted our own survey. We contacted 115 senior IS executives by phone to discuss a variety of issues, including software costs, development tools and techniques, barriers to productivity and ways to overcome them.

For purposes of the survey, respondent companies were broken down into three size categories. Of a total 115 companies, the 41 having revenues of over $1 billion were classified as large; the 38 with revenues between $500 million and $1 billion were considered mid-sized; and the 36 with revenues between $100 million and $500 million were rated small. Charts based on our findings appear throughout the magazine, accompanying related articles.

Thanks go to Harry Klein for helping to plan the survey, to Mina Ahn, Sue Sudan and Mark Miller for conducting it, and to Megan Santosus for helping to compile the results.

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1991 CIO SOFTWARE SURVEY

Barriers to Productivity

Figures indicate average rating of the significance of potential barriers, on a scale of 1 through 5, with 1 being "not significant," and 5 being "extremely significant."

BARRIER	DEGREE OF CONCERN TOTAL	LARGE COMPANIES	MID-SIZED COMPANIES	SMALL COMPANIES
Lack of congruence between development efforts and the company's most pressing business needs	3.20	2.97	3.18	3.44
Excessive backlog	3.03	3.00	3.11	2.97
Lack of resources to purchase development tools	2.98	2.95	2.97	3.02
Lack of development tools capable of boosting productivity sufficiently	2.95	3.47	2.61	2.77
Lack of personal involvement and support from senior management	2.83	2.71	2.68	3.11
Lack of operating systems standards across computer industry	2.77	2.89	2.76	2.66
Lack of cooperation between users and line managers in development efforts	2.76	2.45	2.58	3.25
Too much time spent correcting previous errors or bugs (remedial maintenance)	2.73	2.42	2.89	2.88
Unwillingness of IS development staff to use new tools and techniques	1.99	2.13	1.95	1.88

While it is generally acknowledged that IS staff tend to be resistant to new development technologies (see "IS Resistance," Page 84), respondents to *CIO*'s survey surprisingly ranked staff resistance last on their list of significant barriers to productivity.

1991 CIO SOFTWARE SURVEY

Tools that Reduce the Cost of Application Development

Figures represent those tools and techniques cited most frequently

Large Companies	Mid-Sized Companies	Small Companies
4GLs 22%	4GLs 26%	4GLs 25%
Prototyping 12	CASE 10	Reusable Code 19
CASE 9		Prototyping 14

1991 CIO SOFTWARE SURVEY

Tools that Reduce Costs through the Life of the System

Figures represent those tools and techniques cited most frequently

Large Companies	Mid-Sized Companies	Small Companies
CASE 24%	4GLs 24%	4GLs 28%
4GLs 19	CASE 16	CASE 17
		Reusable Code 14

Companies were also asked to quantify the cost reduction achieved using their most effective tool. Among those few large and small companies that responded, prototyping had a significant edge (67% for prototyping and 32% for 4GLs among small companies). Over the life of the system, mid-sized and small companies found savings from 4GLs the easiest to quantify (33% and 32% respectively). But the few mid-sized companies that gave cost reduction estimates for CASE cited an average savings of 42%, while for small companies the number was 57%.

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Jay Dinwoodie, Senior VP/Information Systems, GE Capital Fleet Services

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Jay’s users agree, especially the 45 mechanics who man the phones helping customers who have car trouble.

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Says Jay, “We bring customers in and show them what we’re doing. Nobody walks away unimpressed, and in fact, SAA’s helped us win a number of new accounts.”

Another big SAA advantage is training time, or lack of it.

“When we first got running, we went to the mechanics’ area for a training session, to get some thoughts for writing a manual. We started at one end of the room, spent a few minutes with each guy, then moved on. We weren’t half-way across the room when the first people were actually using the system, doing real work. We never did write a manual.”

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Their system is now running about 35,000 PC-host transactions a day, and Mr. Dinwoodie estimates that traditional technology would require about 250,000 transactions to accomplish the same work. He says, “Our SAA apps are just incredibly efficient, and they’ve been completely reliable.”

How strange that some people are still asking if SAA is for real.

“It’s just a question of confidence,” says Jay. “We knew exactly where we wanted to go and that ultimately SAA was the only way to get there. So we took that first step, we’ve never looked back, and expectations—both ours and our customers’—have been exceeded.”

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LEADING BY EXAMPLE

Next-Generation Retailing

By integrating applications and consolidating databases in a distributed environment, JCPenney is holding the line on software costs and moving toward its vision of a fully automated, cross-functional retail system

BY MEGHAN O'LEARY

Dave Evans, vice president of information systems at the JCPenney Co. in Dallas, practices what could be called guerrilla software development: "What really matters to us is how fast can we get the application up and running," he said. "I don't care if I buy it, build it, generate it or whatever; the end result—the important thing—is getting the software."

That approach and the retail giant's use of time- and money-saving productivity tools—computer-aided software engineering (CASE), fourth generation languages (4GLs), relational databases and programmer workstations—are allowing JCPenney to move toward its vision of a fully integrated, fully automated retail system in which electronically replenished store shelves are never empty and back rooms are never full. Ultimately, integration will lead to cross-functional systems in which software and information are available from any point in a distributed environment.

A typical transaction at a JCPenney store works this way: Bar codes on purchased items are scanned at the cash register, and that information goes into the inventory management system, which ties into the purchase-order management system. The POM system sends an order via electronic data interchange (EDI) for non-seasonal items to one or more of 1,300 suppliers; the supplier sends the order and invoices the company electronically. (Seasonal items are ordered manually.)

Most of the systems supporting such a transaction are already in place. Penney is currently revamping or writing interfaces for some of them while working on building a common repository for all of that transaction data. In the future, buyers, store managers

DAVE EVANS: *"What really matters to us is how fast can we get the application up and running."*

PHOTO BY DAN BRYANT

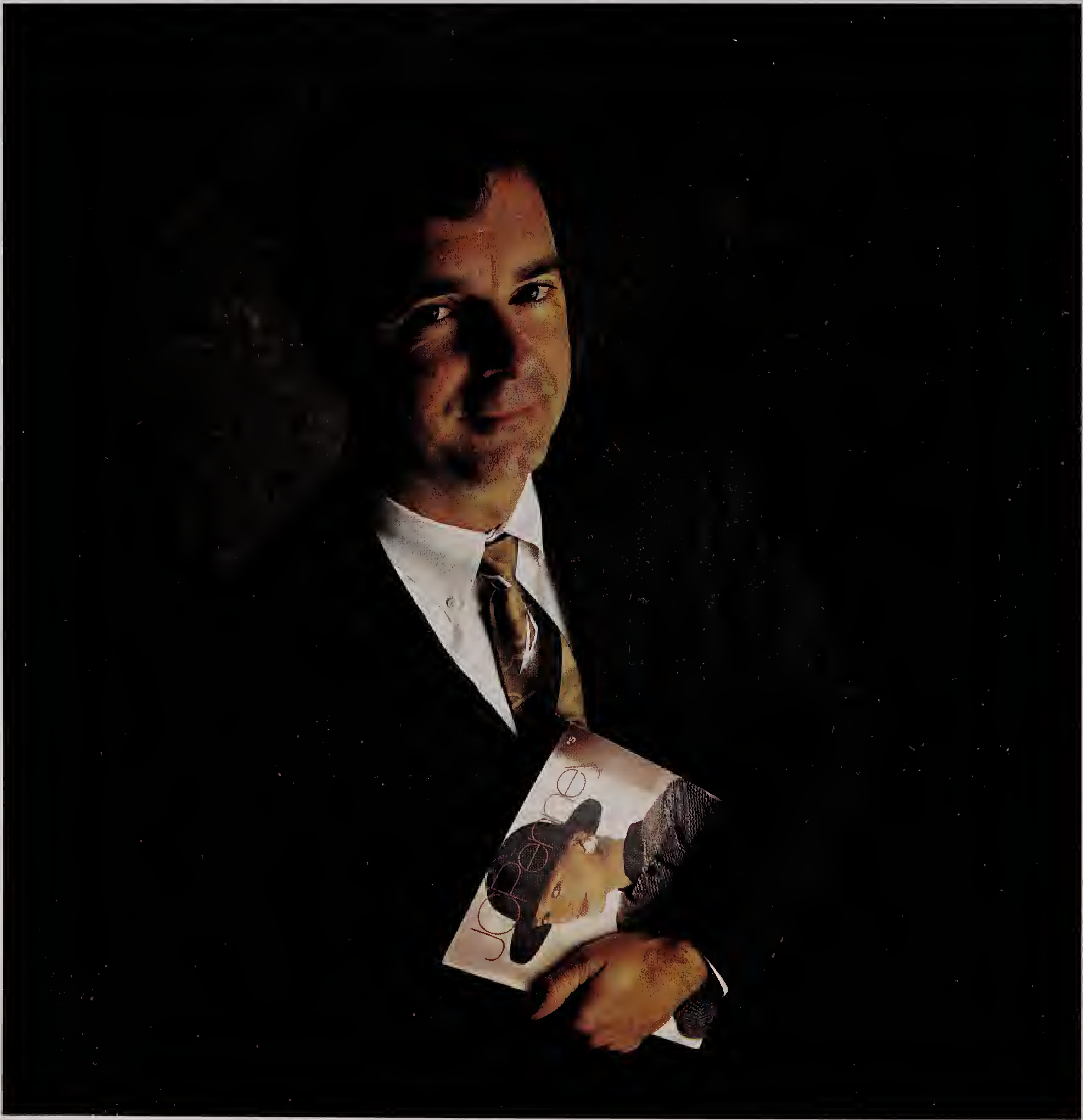
and Penney executives across the country will be able to access all of the data collected at the retail level to find out what's selling, what's not and where the problems are.

"Cross-functionality is very much a requirement for moving forward," said Jeffery J. Michel, manager of systems and programming for retail systems. Michel believes that the company must integrate applications and consolidate databases in order to keep software maintenance costs from skyrocketing. New application development involves taking advantage of resources that already exist within the company, rather than starting from scratch for each department. "We feel that the key to success in the '90s and beyond is going to be speed and flexibility. In order to do that we have to have the right kind of infrastructure."

"What the retail business is about is having the right merchandise at the right time at the right price in the right place," Evans explained. "And if you do that, then customers will flock to your doors. That's been the case for 100 years of retailing, and everything we do is really aimed at that." For Penney, this mission is made more difficult by its recent emphasis on competing with local and regional stores while still maintaining its national leverage.

Since the early 1980s, the company has been upgrading its discount mass-merchandising image to become the only national department store. This has involved discontinuing such items as large appliances, adding more and better national brand-name clothing, and taking advantage of its positioning in malls to compete with regional "anchor" department stores. From a management and information systems perspective, competing locally involves giving store managers the authority and information to make decisions about what is or isn't selling and what they believe will sell. "The challenge we have, then," said Evans, "is to evolve into a new generation of systems without . . . dropping the ball on some important things going on today."

In support of the company's business objectives, Michel explained, "We—like many companies over time—have grown up with a lot of stovepipe systems." These systems in-



JEFFERY J. MICHEL: *"We feel that the key to success in the '90s and beyond is going to be speed and flexibility."*

PHOTO BY DAN BRYANT

clude Penney's point-of-sale (POS) cash-register system, which gathers information on items sold; price-change-management and price-lookup systems; a third-party EDI system for electronic ordering, receiving and automatic replenishment from its suppliers; and sales-tracking and credit-authorization systems.

Penney faces the challenge of implementing its "second generation" of software development in and on top of a warren of separately existing, hierarchical systems built for single departments or business units.

While it upgrades its POS and EDI systems, Penney is also trying to revamp its underlying hardware and software architecture and build interfaces to allow these systems to be fully integrated and cross-functional. Today, Penney faces the challenge of implementing its "second generation" of software development in and on top of this warren of separately existing, hierarchical systems built for single departments or business units.

A year ago, Penney began using Texas Instruments' Information Engineering Facility CASE tool to improve the consistency and quality of its code. CASE, which automates some elements of traditional programming, is integral to Penney's efforts toward efficient software development. It uses a high-level design language that allows a programmer to build an application and automatically generates code based on the design elements chosen. It not only reduces the amount of time a programmer spends coding, but it eliminates redundant and incorrect code.

Under the information engineering concept, a company's data architecture reflects its overall business processes, and a sole repository of data is shared by the whole company (see box). "We have sales information that feeds into the Penney company in six, seven or eight different places," Michel said. Because of this, different departments base their work on different numbers. Penney wants to spend less time deciding whose number is right and more time deciding what the numbers mean.

New applications are being built according to the emerging corporatewide data specifications, with customization and the appropriate interfaces at the business-unit level. Such systems are easier to maintain, not only because of the common data core and standard format, but because the single source of data ensures consistency and lends itself to further development of integrated systems.

To further simplify its data architecture and programming and to move away from departmentally limited systems, Penney is using relational databases based on 4GLs. "We tended to build very complicated, hierarchical databases before, which were very nice but not very flexible," Evans said. Relational databases present data in its simplest form, without placing strictures on how the data will be displayed in future applications.

Less exotic than the software, but equally useful, are the programmer workstations that Penney rolled out to 500 analysts between 1989 and 1990, for the simple reason that they offered desktop power without tying up the mainframe.

The Methodology

Information engineering, the cornerstone of JCPenney's current software development activities, is a methodology that involves building a data architecture from a concept of the corporation as a whole, according to Roger Murray, manager of information system architecture. IE requires that a company identify its critical success factors, its key information needs, the processes that are involved in running the business and the way information is used throughout the company.

The result of this process is a corporate Information Strategy Plan (ISP), which is designed to identify the intersection of business processes and data elements, allowing Penney to build a corporate information system without regard for departments. Penney is now in the ISP analysis stage.

In spite of his investment in productivity tools, Evans prefers, if at all possible, simply to buy software because "the greatest productivity gain in the world is [not to build] it at all." To this end, Evans said, the formerly all-mainframe company has invested in midrange systems such as IBM's AS/400, as well as desktop machines that run DOS and UNIX. Evans believes that the wider range of affordable software for these lower-range computers will give the company many more opportunities to buy high-quality, off-the-shelf applications for use in its distributed environment. "This is where the most, best software is today," he said.

The company decides whether to make or buy its systems on a case-by-case basis. "If you couldn't buy it for half of what it would cost you [to build it], you might consider building it yourself," Evans said. "[But] it's usually less expensive [to buy]; it's always quicker, and it always takes [fewer] resources."

Buying doesn't mean that Penney does without functionality. Vendors regularly customize software for the company. But working with a third party can present a challenge in communication, as in the case of Penney's POS system, for which the IS group was given about 12 months from decision to "ramming speed," as Evans put it.

The wider range of affordable software for lower-range computers will give the company many more opportunities to buy high-quality, off-the-shelf applications for use in its distributed environment.

"We were in such a hurry that we didn't take time to . . . formally specify what customization we wanted our supplier to be doing," he said. "And we didn't give our supplier enough time, [so] the quality wasn't there. . . . Consequently, when we began getting the software deliveries back, they weren't right." After some arguments with the vendor and a few mishaps at the pilot store site, Evans finally decided to send the vendor a copy of Penney's quality-assurance test suite—the software the company uses to test and try to break new systems. He told the vendor, "Why don't you just run this before you deliver the next release, and if you can't run it, don't deliver it."

Key to the success of any systems rollout at Penney, according to Michel, is end-user involvement, especially in light of Penney's widely dispersed stores and its centralized IS management. "Where our systems are the best is where the users are most involved," he said. In keeping with the information engineering methodology, each business unit must have an IT plan that supports its business plan. The units work with the IS group—which charges them for its services—to determine their business and information requirements, where data will come from and what kind of interplay is required between departments and applications.

"We work on what they tell us to work on," Evans said. The exceptions to that are major, cross-functional projects, such as the POS system, for which the IS group must solicit the units' cooperation, or "sponsorship," as Evans likes to call it.

Sponsorship does not always ensure a smooth implementation, however. Testing,

TECHNICAL PROFILE

JCPenney Co. is a $16.4 billion (1989 revenues) retailer headquartered in Dallas, with 1,300 stores across the country.

Large and Mid-Range Systems: Penney runs 19 IBM mainframes, 12 Tandem VLX mainframes, 39 Tandem TXP minicomputers and four IBM AS/400s distributed across data centers in Dallas; Lenexa, Kan.; Columbus, Ohio; and Reno, Nev., with additional sites in Atlanta and Milwaukee. The IBM machines run CICS, IMS and DBS under MVS/ESA and MVS/XA, as well as VM.

End-User Systems: The company has 4,400 PCs in stores and 3,200 in corporate offices for office automation applications and programming. In addition, 38,027 dumb terminals and approximately 40,000 POS terminals are distributed throughout stores, data centers and corporate offices.

Software: For systems development, Penney uses Texas Instruments' Information Engineering Facility, IBM's Focus and Digitalk's Small Talk.

Retail systems include POS, price-change management and lookup, EDI, sales tracking, credit authorization and specialty retailing systems. On the non-retail side, Penney operates catalog ordering and telemarketing systems, corporate electronic mail and decision support.

Data Network: An MNSF/SNI backbone network with nodes at the company's regional data centers around the country connects stores and headquarters via IBM 37XX front-end processors, over IBM S/1s.

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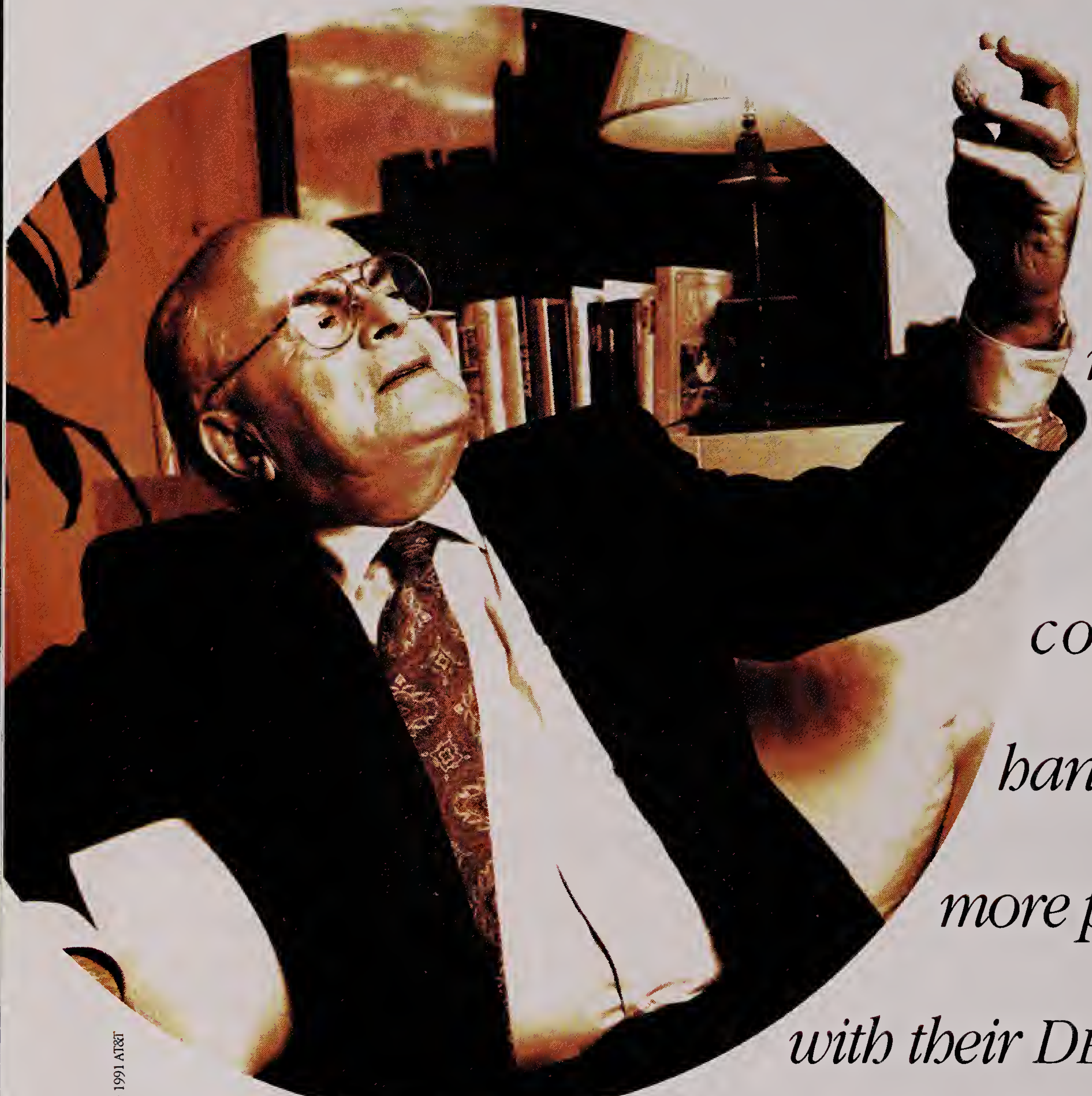

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JAMES CASH PENNEY *(top right) opened the Golden Rule Store 89 years ago in Kemmerer, Wyo. From those humble beginnings JCPenney has grown into a retailing giant. And a sagacious use of technology, from the early computers of the '60s (right) to the integrated systems of today, has helped it become the only national department store.*

PHOTOS COURTESY JCPENNEY ARCHIVES

regression testing ("testing the stuff you had before to make sure you didn't break it when you were putting in the new stuff," Evans explained), integrating, and developing interfaces between systems are all major productivity concerns for Penney. In addition, the company's decentralized operations put a special emphasis on the need for quality assurance and effective training. "When you're rolling out to this many places, it's a lot different than if everything was going on here in the office," Evans said. A smooth rollout, such as Penney's ongoing replacement of nearly 40,000 POS terminals, is critical to keeping the company's profit margins up in spite of interruptions and learning curves.

The final obstacle to software productivity for Penney is the inertia of the software developers themselves. "We still face a challenge in that we're changing the way people work, and the people already know how to work and they don't want to change," Evans said. "There's an old saying that if you have a hammer, every problem looks like a nail. Our development people all have a hammer—CICS and Cobol—they know how to do this stuff. They're really good at it." As a result, Evans has faced a challenge in getting programmers to use new productivity tools.

> **"Where our systems are the best is where the users are most involved."**
>
> *–Jeffery J. Michel*

As a veteran IS user and developer, Evans takes this reluctance to slow down development in order to learn new tools very seriously. "This is a valid argument, because our project managers make an estimate and a schedule and are held accountable for [sticking to them]. And it doesn't make any sense for them to take the risk of using a new tool, [because] we tend to measure them on a project-by-project basis. So I think they had a good case. It took us a

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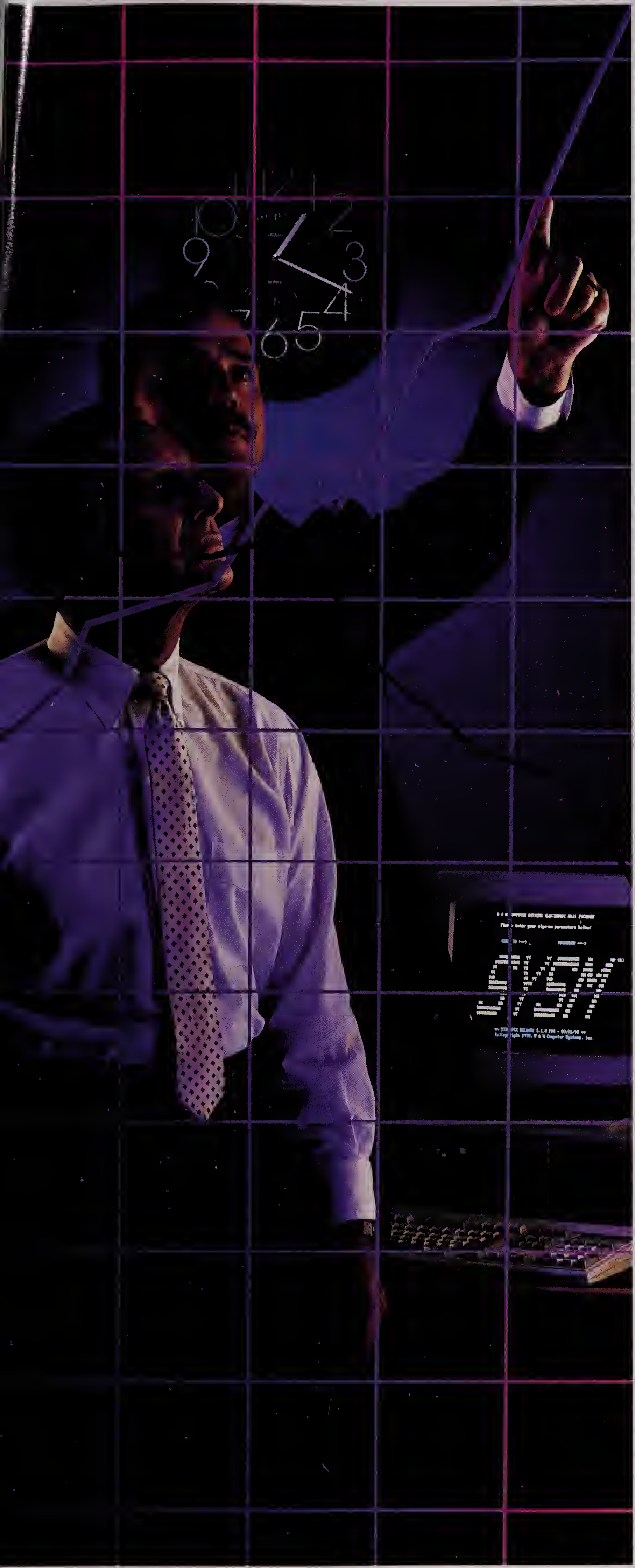

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while and some leadership to [address that problem]. And it's something we're certainly not done with."

Penney faces other future battles. The biggest benefits of its recent software productivity efforts have yet to be seen. As Michel pointed out, while CASE and information engineering represent a move from automation and simple cost avoidance to systems improvements for better decision-making, their cost benefits are not easily measured at the outset.

"We feel very strongly that the updates and changes to the system are where the major bang for our buck will come." *–Jeffery J. Michel*

"Our initial tests have [shown] no productivity gain as far as the initial build," Michel said. "But part of that is all the training that we're getting. We spend a lot more time upfront on the quality of the architecture. And response from users has been encouraging from the standpoint that the system does what it's supposed to do. We feel that we'll [eventually] see productivity gains in the initial builds, but we feel very strongly that the updates and changes to the system are where the major bang for our buck will come."

In spite of the productivity learning curve, a compelling case for implementing some of its development methods can be made from the fact that Penney's spending on IS development has fallen in recent years while development itself has remained constant. "We're spending—oh, this will kill all the other guys that read this—less today on IS than we did in 1984," Evans said. "Our MIPS are growing at 18 percent a year, and our cost per delivered MIPS to users is declining at 16.8 percent a year." Evans believes his experience should be a strong warning to CIOs who are considering outsourcing software development and maintenance in order to save money. "I'll just say to all these guys who are signing these fixed-price, 10-year contracts that they should be

One-Stop Computing at the InfoStore

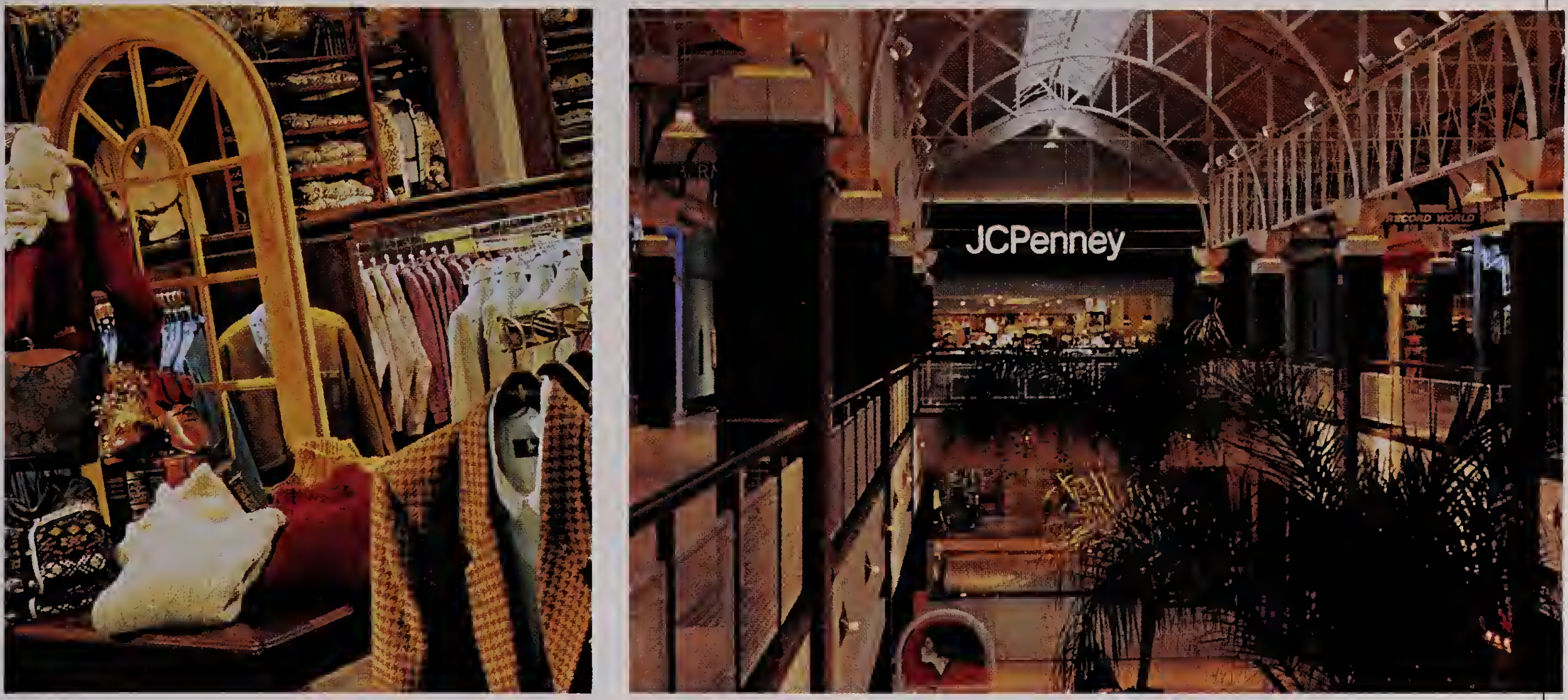
While JCPenney's software development methods are down-to-earth, the company's goal of cross-functional, distributed computing sets the stage for a loftier vision

JCPenney's InfoStore is "more of a concept than it is a project," according to Jeffery J. Michel, manager of systems and programming for retail systems. Nevertheless, Michel's group has prototypes of the system, which would be based on a common relational database fed by all of the transaction processing systems of the Penney Co. It would run on a client/server architecture that would allow users to access information and run applications from any point in the company.

At the front end would be software tools to allow the user to display information in any report format. So, for instance, a regional buyer could call up holiday sales figures for a group of seasonal items for a region or a single store. The system would let the buyer drill down as far as which colors were selling. The system would serve anywhere from 10,000 to 20,000 Penney associates and feed a corporate executive information system.

The key to the usefulness of such a system, according to Michel, is in making the data available in a form as close to the original transaction form as possible while providing a graphical user interface at the front end and powerful tools to let users organize the data in the form most useful to them.

The system would provide Penney with a level of reporting efficiency and information availability that is unheard of today. "Most reporting in Penney stores today is paper-based," explained Michel. "[Associates] get buried with information. We've automated almost all that can be automated. Our challenge in looking forward is to turn data into



JCPENNEY *has been taking advantage of its positioning in malls to compete with regional "anchor" department stores, a strategy that makes the effective use of information systems more important than ever.*

PHOTOS COURTESY JCPENNEY CO.

asking for a 16 percent annual reduction."

One of the problems with third-party software development, in Evans's view, is the "artisan" attitude toward the work. "It's all custom work, and we need to stop that," he said. In addition to the productivity tools he himself uses, Evans believes that object-oriented programming software (OOPS) holds promise for reducing the cost of developing software. OOPS has many routine programming chores built in and can greatly reduce the amount of time programmers spend documenting code. The language can also be customized to perform chores related to one's business. "So, [for example], I can add to the language sales-tax calculations that our programmers have solved 1,000 times."

Penney's spending on IS development has fallen in recent years while development itself has remained constant.

While Evans estimates that 80 to 90 percent of his critical systems are up and running, he sees a lot of work ahead before his group is up to speed with its new development tools and making real headway in achieving true distributed computing and seamless cross-functionality. His programmers' increasing proficiency with their new productivity tools will, he believes, bring his vision closer. "The technology is always ahead of our ability to use it effectively," he said. "It's still a journey to get penetration and expertise—to get as good at it as we were at using the hammer." CIO

information."

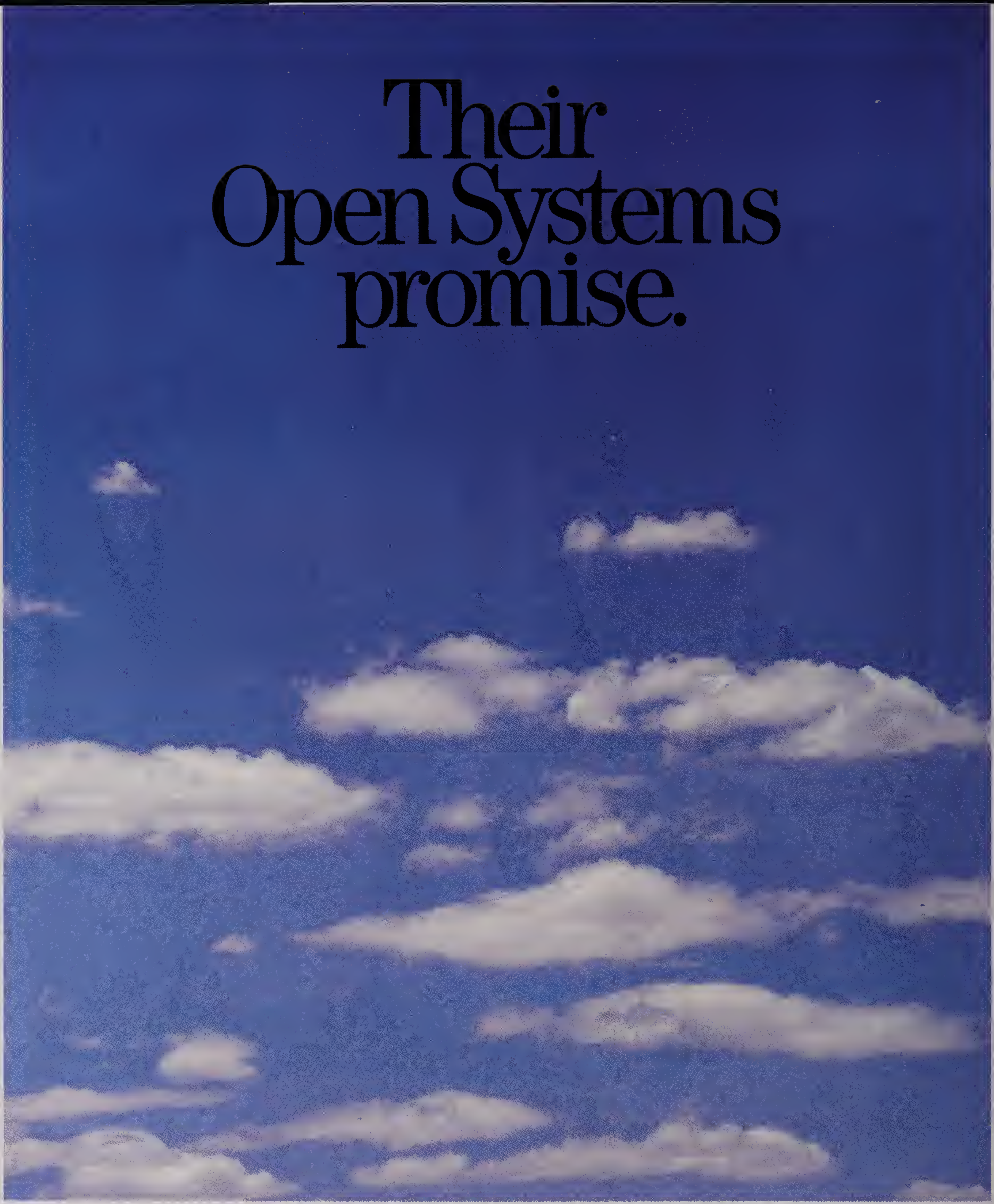
Michel believes that InfoStore holds particular promise for regional and store buyers, who need to communicate visually with one another. (The buyers currently use a direct-broadcast television network to show and buy goods.) The InfoStore prototype uses a digital camera to capture images, offering true colors and close-ups of garments so buyers can determine such things as various articles' texture and weight. Other images, such as representations of store layouts and pictures of current newspaper ads, could also be added.

Despite his big plans for the system, Michel does not expect to have a pilot of InfoStore up before 1993 or later because "client/server is more promise than reality at this stage."

Still, the InfoStore system promises to allow Penney associates to make better decisions by relieving some of the demands on their time.

"The pressures get worse and worse," Michel said, "and labor costs are never going to come down. We need to do whatever we can. That's the hardest job of a retailer."

–M. O'Leary



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CONTROLLING COSTS

The Runaway Train

The throttle is open and the boiler is stoked, and the cost of software resources is highballing out of sight. What can the CIO do to keep from being derailed?

BY THOMAS KIELY

The price of hardware may be in free-fall, but software costs are headed north for the foreseeable future. To cope with the inflation, CIOs are outsourcing, downsizing and using new productivity tools. But a few consultants believe that to get a long-term strategic grip on software costs, companies must also rethink the role of IS in their organizations.

As certain as CIOs and analysts are that the cost of software has been rising, is still rising and shall continue to rise, no one is quite sure just how high those costs will go, or how fast. The fuzziness may be the nature of the beast. Cost estimates for software can be as plastic and intangible as software itself. Some companies have no idea how much their end users are spending on personal computer software; some can't calculate how much they spend on maintenance. Is user training a software expense? Development costs vary widely; so do software personnel costs.

At best, any profile of software costs has to resemble a cubist painting—an abstract image, fragmented and glimpsed simultaneously from several odd angles. For example, International Data Corp. (IDC) of Framingham, Mass., notes that the world has been spending about 20 to 25 percent more each year for packaged software and services since the mid-1980s. But this is a number in need of context: Software vendor revenues reflect a broadening customer and product base as well as higher prices. Those numbers also include new service markets, increased revenues from maintenance, and so on.

More important, revenue figures for software vendors shed no light at all upon the costs associated with the billions of lines of code that are the joists and beams of most corporations' business systems—much of which was written by IS groups during the last two to three decades. IS groups are still churning out a considerable amount of new in-house code. Companies are also buying customized code from vendors and integrators or tailoring packaged software to meet the unique needs of the corporation. Here is one oblique measure of that: In 1984, the U.S. Department of Commerce concluded that although the trend toward packaged

software had been steady since 1979, the production of customized or integrated systems software would account for more than 50 percent of the software market in the world's developed nations until the mid-1990s.

Meanwhile, CIOs say, the costs of maintaining existing systems are rising, too. Estimates for maintenance costs vary. While some analysts assert that corporations today dedicate as much as 80 percent of their resources to maintaining existing systems—a figure that vendors of computer-aided software engineering (CASE) tools like to trot out—IS executives surveyed by *CIO* indicate that, on average, 58 percent of their software budget goes toward maintenance.

Asked by *CIO* to rate their concerns about the cost of software, IS managers put at the top of the list the expense of developing new in-house software and the cost of maintaining (fixing or enhancing) existing systems. Next on the list came a cluster of software licensing issues. Or to put it another way, CIOs say that their rising costs are attributable to people, people, people—and the damn vendors.

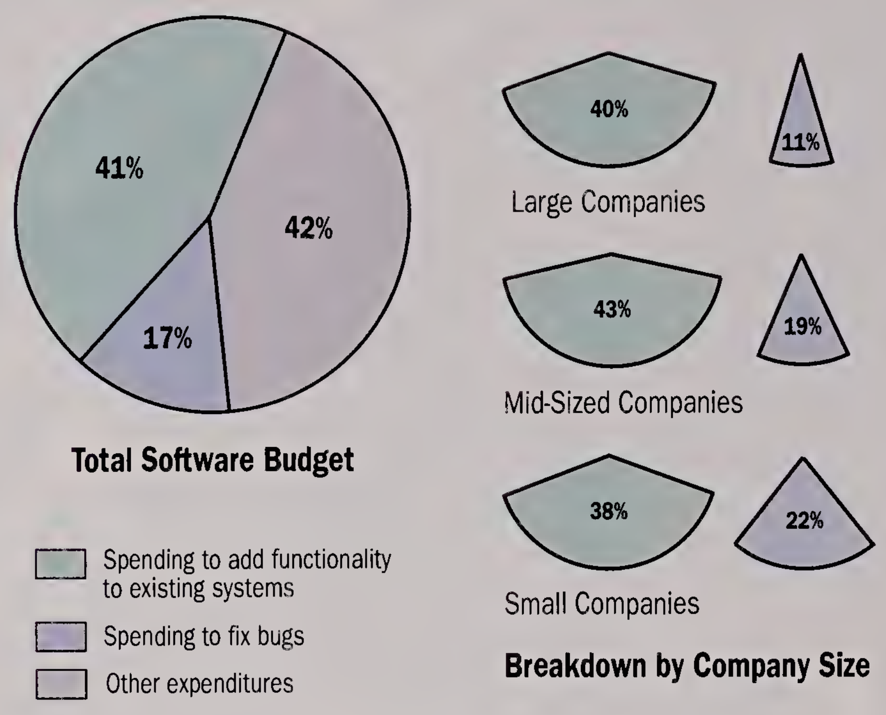
People top the list because employee salaries have become one fat, hair-raising sum on the IS manager's budget sheet. "The biggest increase in our costs is people," said Diane Smigel, vice president for corporate information services at the John Hancock Mutual Life Insurance Co., in Boston. Her words were echoed by nearly a dozen other IS executives interviewed for this article. Smigel added, "We're cutting back staff in operations [to eliminate routine jobs], but the remaining jobs demand a much

IS executives indicate that, on average, 58 percent of their software budget goes toward maintenance.

ILLUSTRATION BY CHRIS GALL

1991 CIO SOFTWARE SURVEY

Maintenance Costs



Taken together, respondents to *CIO's* survey devoted 58% of their software budgets to adding functionality and fixing bugs; the *IBM Systems Journal* estimates that most companies spend half of their "data-processing" budgets on maintenance (see "Managing Maintenance," Page 74).

higher skill level. Our people costs are escalating."

At the same time, the demand for new software has been rising. A survey of Fortune 200 companies conducted by IDC in 1989 indicated that the corporate workload is growing at a rate of 22 percent per year, but staffing levels are flat or diminishing. "The way that's getting done is software," said Robert Tasker, vice president for software services at IDC. "More and more functions are being automated. The increased functionality comes from software."

CIOs look at maintenance as a people cost, too. The aging software used in the day-to-day operations of corporations, universities and government agencies increasingly requires more darning and mending—that means more staff attention. IS staff must also amend or reshape the old stalwart applications to meet the changing needs of the organization.

"Our in-house software is never static," said David Chzaszcz, director of corporate MIS at United Technologies Corp. in Hartford, Conn. "We're always adding to it. So we're constantly growing the number of people on it."

In *CIO*'s survey, IS executives rated maintenance costs—either for fixing bugs and satisfying previously stated requirements or for adding functionality—as their most pressing cost concern following in-house development, and more than a third tagged maintenance issues as the single factor most responsible for driving up software costs.

IS executives estimated that 17 percent of their software budgets go toward fixing bugs, although that figure was slightly higher for small companies (22 percent) and medium-sized companies (19 percent). In contrast, they said that 41 percent of their software budget is consumed by adding functionality to existing systems.

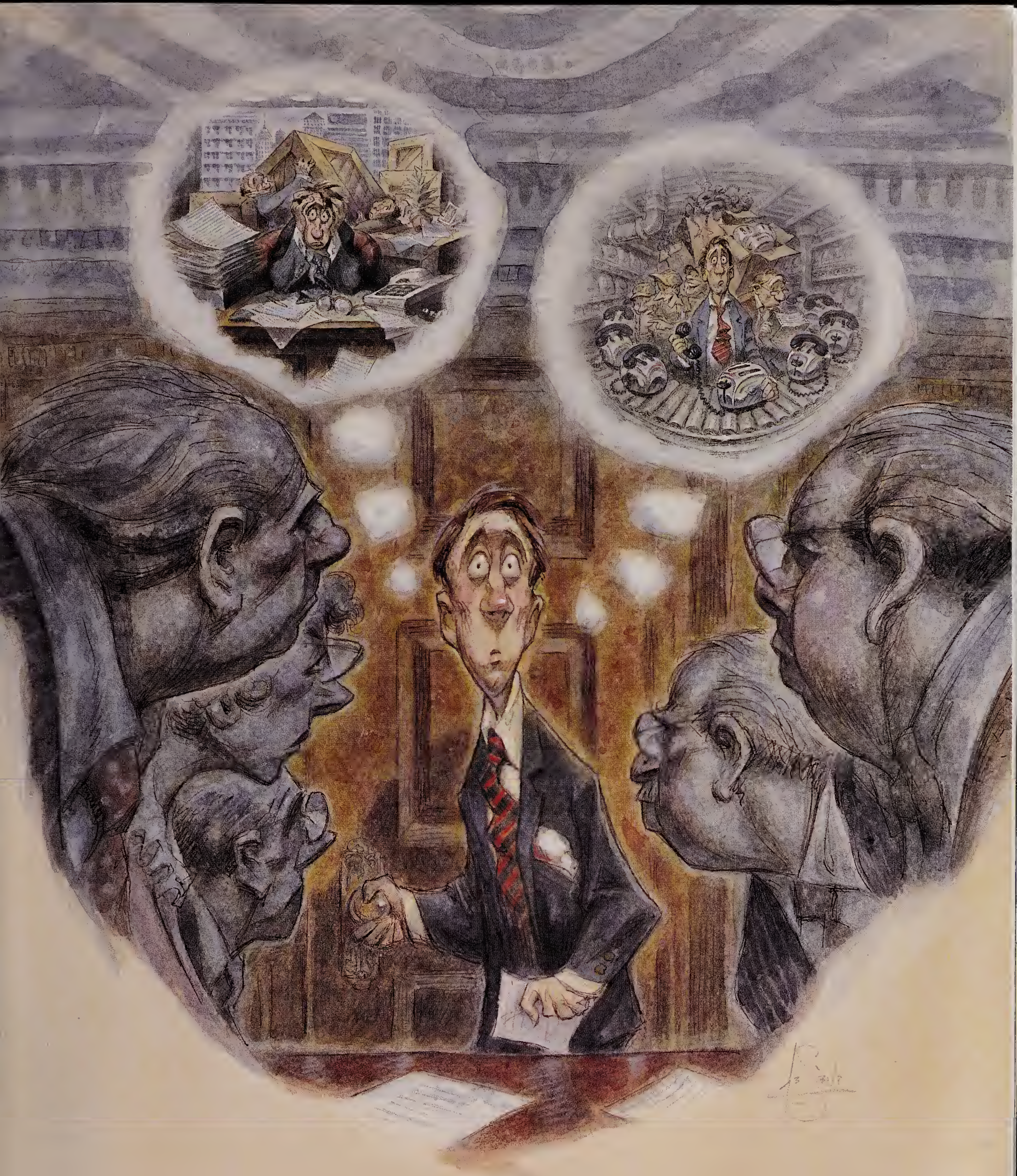
Wayne Sanford, director of business systems analysis at the Bath Iron Works Corp. in Bath, Maine, prefers to call this latter category of maintenance "enhancement" work. "Maintenance is fixing things that are broken," he said. "This is a small part of the job."

But changing software to meet the changing needs of the business or its customers "is where the big job is. One reason software is called 'soft' is because it is infinitely malleable. But as it becomes embedded in the business, it becomes hard." As business functions are embedded into code and people become used to the systems they use, managing migrations can become a nightmare.

> **"One reason software is called 'soft' is because it is infinitely malleable. But as it becomes embedded in the business, it becomes hard."**
>
> *–Wayne Sanford*

"Part of the reason maintenance costs are so high is that we do things to make them high," observed the software manager of a large medical technology subsidiary of a Fortune 500 corporation. "We structure them that way."

IS groups tend too often to tackle "things we're comfortable with," he continued, enhancing or even rebuilding the familiar—such as payroll systems—rather than leaving them alone and "turning our attention to new technologies to see what we can do with them. There is no concept of 'doneness' in our industry."



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A software supervisor at a large manufacturing company who asked not to be identified said that "in the past we tried to write everything ourselves. But more and more we're buying vanilla packages."

Given all this, it isn't surprising that 48 percent of *CIO*'s survey respondents said they had trimmed staff from their departments to cut costs. Large companies are slimming more readily than small companies—54 percent of the respondents from large companies reported that they had reduced staff in IS during the last 12 months, as opposed to 39 percent of the IS executives from small companies.

Several companies reported that they were doing little or no new development; they have assigned their entire staff to maintenance tasks. Most CIOs aren't standing still, however. They are trying a number of

1991 CIO SOFTWARE SURVEY

Leading Cost Concerns

Figures indicate respondents' degree of concern, on a scale of 1 to 5, with 1 being "not concerned" and 5 being "extremely concerned."

COST FACTOR	AVERAGE DEGREE OF CONCERN
New in-house development	4.05
Maintenance to fix bugs and satisfy previously stated requirements	3.82
Maintenance to add functionality	3.80
License fees	3.64
Availability of site licenses	3.47
Customizing packaged software	3.45
End-user purchasing	3.04
Deployment of staff in operating departments	2.80
License transfer fees passed on from outsourcing vendors	2.24

Broken down by company size, there was little difference among CIOs' concerns.

The Small Get Smaller

Downsizing is becoming a popular cost-containment strategy for small and medium-sized companies

Among the respondents to the *CIO* software survey, 49 percent said they have tried to hold down the costs of software by moving production systems to less expensive processors. But only 37 percent of the IS managers from large companies have tried it, as opposed to 60 percent and 50 percent respectively of the respondents from medium-sized and small companies.

Downsizing is certainly easier for companies that have fewer gargantuan processing tasks. New, more powerful microcomputers and software applications designed to exploit that power make it possible for many companies to shift functions like payroll, human resources and computer-aided design to a PC. Kendall Healthcare in Mansfield, Mass., has moved selected systems from its IBM mainframe and midrange AS/400 computers to personal computers, and Walter Layden, Kendall's director of MIS, estimates that he has cut the license and maintenance fees for those applications by 50 percent.

But big companies aren't ignoring the trend, either. Raytheon Co. in Lexington, Mass., has installed over 9,000 PCs in its corporate division during the last five to six years, usurping a number of applications formerly run on the mainframe. Bob Turcotte, manager of the microinformation center for Raytheon's corporate offices, believes that heated competition among a growing number of PC software vendors will continue to drive down microcomputer and LAN software costs, making downsizing an increasingly attractive option for companies as big as his own.

That conclusion is borne out by a February 1990 Gallup Poll of 251 executives at Fortune 1,000 companies. According to the poll, conducted by the Software Publishers Association, the Gallup Organization and *Computer Reseller News*, 29.8 percent of a Fortune 1,000 company's computing needs are met by microcomputers (up from 16.2 percent in 1988) and 54 percent by mainframes (down from 69 percent in 1988).

–T. Kiely

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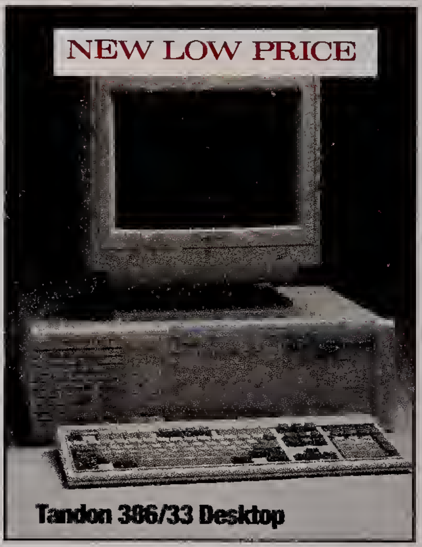

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Fourth-generation languages were cited by 30 percent of the respondents as the tool or technique that helped most to reduce the costs of developing applications—for an average reduction in cost of 40 percent.

strategies to hold down development costs. A whopping 86 percent of the respondents reported that they are purchasing off-the-shelf software wherever possible. A software supervisor at a large manufacturing company who asked not to be identified said that "in the past we tried to write everything ourselves. But more and more, we're buying vanilla packages."

Still, many IS executives trying this tack report that they must customize off-the-shelf packages in-house to meet their organizations' business needs—which is a development cost. When vendor updates arrive, IS staff spend a lot of time carefully transferring the old whistles and bells to the new package; then they must test, tweak and patch the application—which is a maintenance cost.

Kendall Healthcare in Mansfield, Mass., has bounced the customization burden back onto the shoulders of its software vendors. "We purchase packages for everything," said Kendall's director of MIS, Walter Layden. "Then we have the vendor modify it for us." By purchasing off-the-shelf software, he has reduced the size of his development staff, cut his software license fees by moving production systems from costly mid-range machines to personal computers, and outsourced his development and maintenance. He figures he has shaved his software costs by 15 percent.

One large Chicago-based company has begun to use contract programmers as a way to hold down the cost of new projects. "We might need 40 programmers for a project," said one of the corporation's IS executives, "but [we] won't need 35 of them when the job is done, so we contract out."

A few of the surveyed companies report that they are studying the feasibility of having some of their development work done

While maintenance to add functionality was the number-one cost driver for large companies, new in-house development was mentioned most frequently by mid-sized organizations. Small firms split their votes between maintenance and software license fees.

1991 CIO SOFTWARE SURVEY

Factors Driving Up Costs

Figures indicate number of respondents citing each issue as the single factor most responsible for driving up software costs in their companies or business units.

COST FACTOR	NUMBER OF MENTIONS			
	TOTAL	LARGE COMPANIES	MID-SIZED COMPANIES	SMALL COMPANIES
Maintenance to add functionality	22	10	6	6
Maintenance to fix bugs and satisfy previously stated requirements	19	5	7	7
New in-house development	18	6	9	3
Software license fees	14	3	6	5
Customization of purchased software	7	2	3	2
Availability of site licenses	7	3	3	1
Other	5	4	1	0
Deployment of development and maintenance staff in operating departments	4	1	2	1
End-user purchasing	4	3	1	0
License transfer fees passed on from outsourcing vendors	1	0	1	0

1991 CIO SOFTWARE SURVEY

Cost Reduction Methods

Figures indicate percentage of respondents who have tried to hold down or reduce software costs by the stated methods.

METHOD	TOTAL	LARGE COMPANIES	MID-SIZED COMPANIES	SMALL COMPANIES
Purchasing off-the-shelf wherever possible	86%	88%	92%	78%
Using software development tools	74	73	76	72
Moving production systems to less expensive processors	49	37	60	50
Reducing the size of development staff	48	54	50	39
Outsourcing development projects	41	32	52	39
Having development done in the business units rather than in central IS	38	41	47	25
Outsourcing maintenance tasks	19	24	24	8
Having development done outside the U.S. (e.g., Singapore, India, Ireland)	4	7	5	0

The estimated cost savings realized in 12 months through these efforts averaged 15% (11% for large companies, 18% for mid-sized, and 15% for small). However, 14% of all respondents answered that they didn't know what savings had been achieved. (This broke down into 10% for large companies, 11% for mid-sized and 22% for small.)

outside the U.S. "We've looked into it," said an IS executive at a large Wall Street firm. "We may be willing to work through an overseas network." He mentioned India, Singapore and Ireland as the countries likely to get the work.

Development tools are gaining popularity as well. Asked which tools or techniques are proving most effective in overcoming barriers to productivity, companies mentioned fourth generation languages (62 percent), CASE products (34 percent), prototyping (34 percent) and reusable code (32 percent). Fourth generation languages were cited by 28 percent of the respondents to another question (24 percent of the total sample) as the tool or technique that helped most to reduce the costs of developing applications—for an average reduction in cost of 40 percent. They were also the most frequently cited tools for reducing costs over the lifetime of the system. Large companies, however, cited CASE as the most economical tool over the life of the system—with an average cost reduction of 22 percent.

CASE can be a slow and expensive investment, however. New converts to CASE tend to underestimate "the significant investment in the learning curve," said an IS manager at a large Midwestern utility, who learned by experience. "CASE is *very* expensive, and the learning curve is *very* steep."

According to Ken Orr, development methodologist and founder of The Ken Orr Institute in Topeka, Kan., quoted in the March 1990 issue of *System Development*, an MIS organization with 100 staffers can expect to pay $1.5 million for the initial CASE investment and $350,000 per year after that. Of these costs, 20 percent will be for software, 20 percent for hardware and 60 percent for training, support and miscellaneous expenses.

> **"Just to keep our customers safe and happy, we've got to use a bigger and bigger chunk of our IS budget to pay for fees when we would like to use that money for new applications."**
>
> *–David Chzaszcz*

"I have a contrarian view," said Tony Picardi, director of application tools and system-level software at IDC. He argues that CASE on the workstation allows users to develop software on more cost-efficient boxes and then port the application to the mainframe. Also, Picardi asserts that CASE tools allow companies to employ less specialized (and therefore less costly) staff, to do the job faster and to do it cleaner—also cutting down on future maintenance costs in the bargain.

People costs aside, IS managers also grumble about rising fees for systems software from vendors and escalating upgrade and maintenance fees on third-party software. Analysts say they have reason to grumble. "In the early '80s, IBM systems software used to go up [in price] 7 percent to 8 percent per year," said Barbara Sannerud, program director at the Gartner Group Inc., a Stamford, Conn., market-research firm. "With some of the new systems packaging, we're seeing systems software increase up to 10 percent to 15 percent on a compound annual growth rate."

> **"If you were really trying to be strategic about your software costs, the tendency to focus on lowering the unit costs is important, but it's not the whole answer."**
>
> *–David G. Robinson*

Maintenance fees for third-party software from such companies as Computer Associates International Inc. and Oracle Corp. are also pinching IS budgets, said United Technologies' Chzaszcz. Vendors tie maintenance fees to list prices—which seem to creep up every year—even though customers rarely pay list price anymore. Those fees range from 10 to 20 percent of list price on an annual basis. "It's frustrating," said Chzaszcz. "Just to keep our customers safe and happy, we've got to use a bigger and bigger chunk of our IS budget [to pay for fees] when we would like to use that money for new applications."

Others complain that vendors such as IBM have begun to charge for services they once dispensed for free, or that both hardware and software providers are steeply raising the maintenance fees on packages they want to phase out.

Still others cited as frustrations tiered licensing (the bigger the machine the software package runs on, the higher the monthly license fees) and the reluctance of vendors to enter into site licensing arrangements. One CIO accused a vendor of using fees to "obstruct" his company's efforts to consolidate systems.

Analysts say all this reflects shake-ups in the industry. As profits from hardware fall, vendors are seeking to make up the loss in software and services. Third-party software vendors are pricing their wares to reflect changes in the market, too. Vendors like IBM and Computer Associates defend their pricing policies as equitable in this brave new world of downsizing, outsourcing and networking.

But vendor fees and people costs aren't the real issue, say some observers. "What is principally driving software costs is how IS is managing demand," said Raymond T. Hall, vice president in the Information Systems Group in the Dallas office of Booz-Allen & Hamilton Inc., a management consulting firm. In most companies, IS does not manage demand at all, Hall asserted. Business units create their IS wish lists, and IS "does one for Harry and one for Sue. But no one ever looks at what are the most important projects for the company." As a result, companies waste valuable IS dollars on projects that may have no corporatewide strategic value.

David G. Robinson, president of the Index Group Inc., in Cambridge, Mass., agrees. "The systems-development process in many organizations is managed way down too low for the kind of management perspective that creates very large benefits," he said. "If you were really trying to be strategic about your software costs, [the tendency to focus on] lowering the unit costs is important, but it's not the whole answer."

Although there is now some interest at the top of IS organizations in concentrating on more valuable systems, said Robinson, "there isn't much interest in shooting low-value systems. There are a lot of systems that get built that are too large or too ill-conceived. The screening systems aren't there to prevent them." When the money is spent on the wrong systems, "you've lost an opportunity for higher productivity for your software dollars."

The strategies CIOs employ to hold down software costs are important, Robinson said, "but there's also the question of just not attempting to build as much software, and having a higher business yield on it.

"It's another perspective," he concluded—another angle in that cubist image of software costs. CIO

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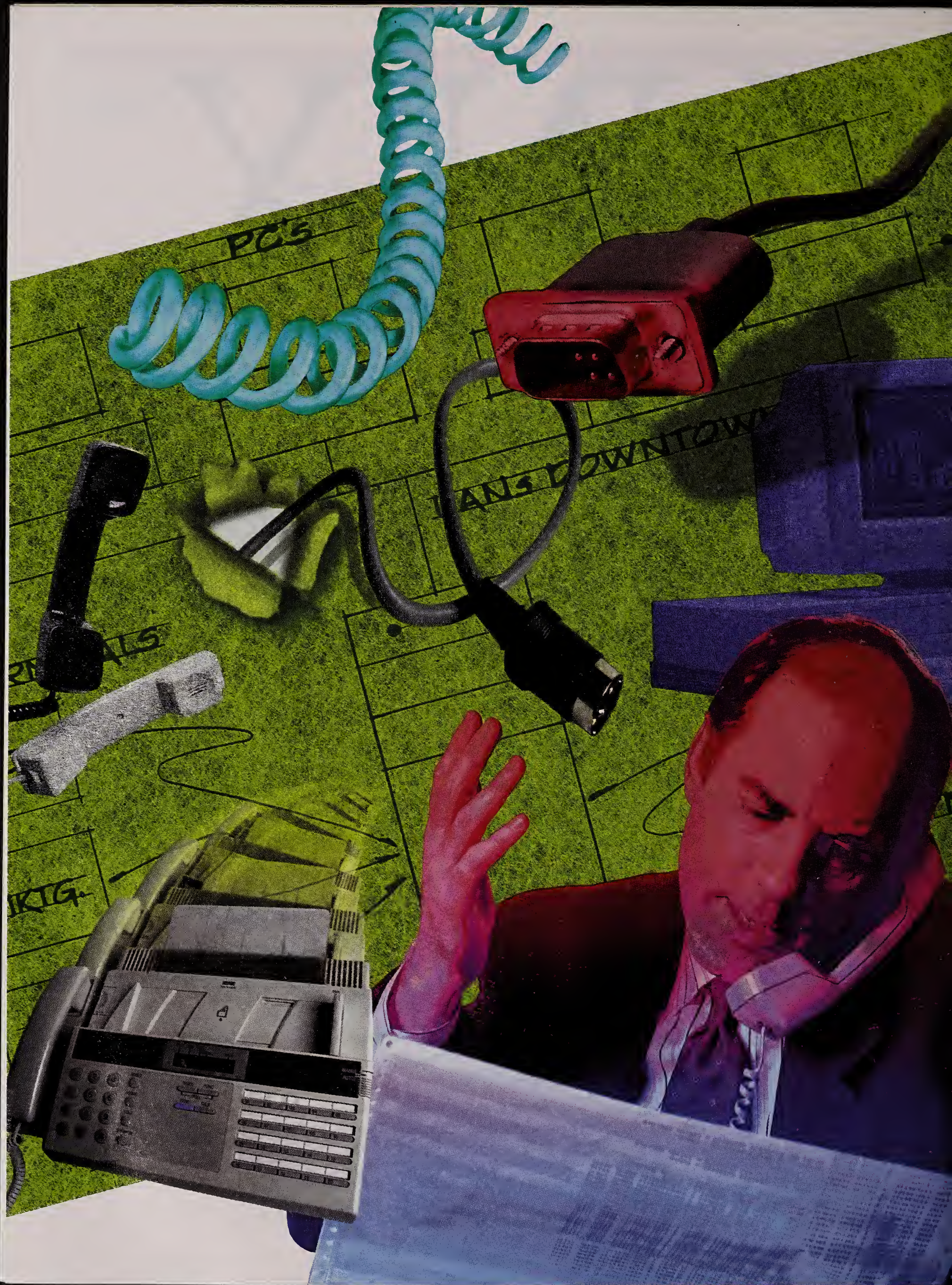
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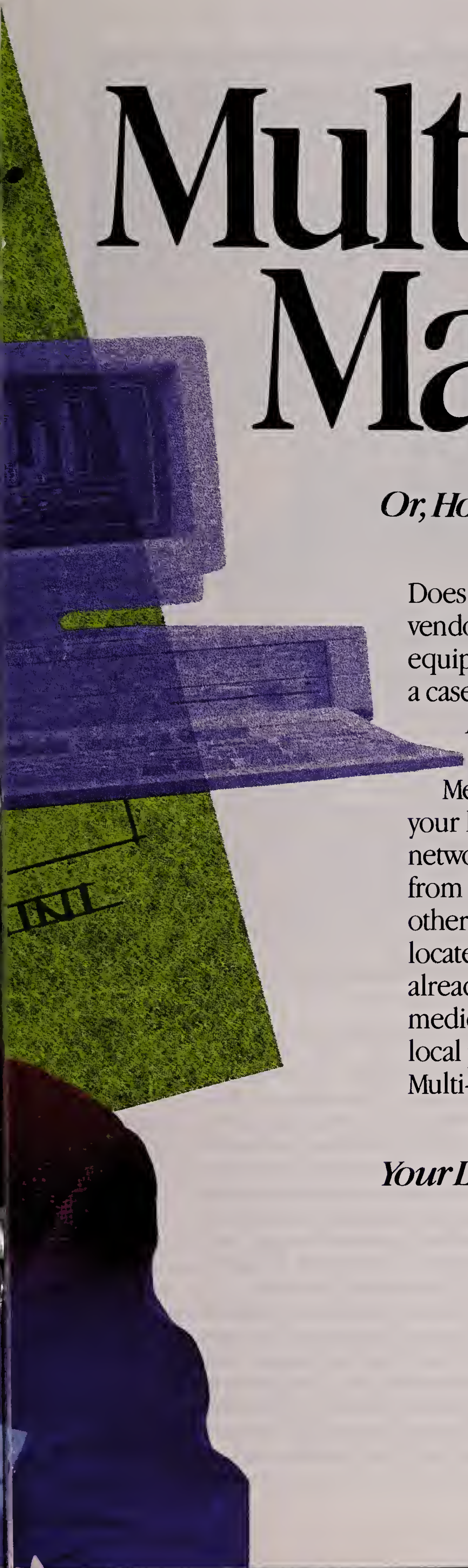

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MASTERING METHODOLOGY

Beyond Rube Goldberg

New application design and engineering disciplines could bring an end to unwieldy, maintenance-intensive software 'contraptions'

BY MICKEY WILLIAMSON

Software may be a product of the intellect, but the people who create it are beginning to realize that it can be engineered with the same kind of discipline used to design and build such objects as bridges and microwave ovens.

As a phrase, software engineering has been around for a generation. As a practice, it is so new that no standards exist to define it. This much we know: Software engineering implies rigorous project management, emphasis on defining requirements, prototyping, reusability of software components, and quality and productivity measurement with a view toward continual improvement of the development process.

Thorough analysis of system requirements is emerging as the most important phase of the development process, experts say. "The more thoughtful you are in the beginning, the more it pays off at the end," said Ken Orr, development methodologist and founder of The Ken Orr Institute in Topeka, Kan., and the author of books on requirements definition and structured systems development. "Almost all the really big mistakes are made early."

According to Paul Ward, a principal in Software Development Concepts, a New York-based training and consulting firm, "Most debugging really involves finding errors in conception about what the system should do." Compared to correcting an error during the requirements phase, fixing it after the code has been written can cost "somewhere between a factor of 100 and a factor of 1,000 [times more]," he said.

One reason that applications so often fail to satisfy the people for whom they were built is that IS organizations typically fail to approach systems design as a cross-functional activity, according to James C. Wetherbe, professor and director of the MIS Research Center at the University of Minnesota in Minneapolis.

For example, Wetherbe said, an order-entry system affects the sales, credit, manufacturing, warehouse and shipping departments, so it is not enough to interview only the people who process orders. "The whole reason for putting in a new system is so that [the company] can make better decisions," he said. Good decisions, he added, must consider every related business function. "It's almost the equivalent of an environmental impact study," Wetherbe concluded.

Instead of the months or years that an environmental impact study takes, however, requirements are often hammered out in a joint application design, or JAD, session. JAD, an IBM trademark, has come to be used as a generic term, like Kleenex and Xerox. JAD puts information systems professionals and their clients from the business side of the enterprise in a room for three to five days for a highly structured process of analysis and logical design. A trained facilitator runs the JAD workshop and is responsible for both preparation and follow-up.

At Campbell Soup Co., headquartered in Camden, N.J., JADs are always cross-functional, said Harry Wallaesa, corporate vice president of MIS. "That's absolutely necessary," he said. "We're building cross-functional systems. Sharing information and acting as teams is new for most companies, but it's necessary." One result, Wallaesa said, is improved acceptance of new systems by the user community. "People know what they're getting all along the way because they're involved in the process," he explained.

Not only do JAD sessions result in more satisfactory systems, they also help technical professionals learn about the business

Thorough analysis of system requirements is emerging as the most important phase of the development process.

ILLUSTRATION BY CHRIS GALL

they serve while businesspeople learn about the possibilities technology offers. A surprising byproduct, according to Ronald J. Kuznicki, manager of the automated systems environment effort at USAA Information Services in San Antonio, is that JAD participants use the sessions to iron out business issues. "We really serve as the catalyst for the businesspeople to understand their own processes better," Kuznicki said.

Sometimes the mechanism for building better understanding of the business starts with an all-out effort at defining just what the company does. This process, often described as enterprise modeling or business-area analysis, involves looking at every business operation and the information it requires. The trick, said Wetherbe, is to ask the right questions. The proper technique involves exploring first organizational goals and purposes, then the processes that support them, and finally the kinds of information that support the processes.

> **"When you talk about project management, you're talking about a framework to support all life-cycle phases. I call it DP-101. It's just good management."**
>
> —*Joseph L. Smith*

Defining an enterprise by the information it uses, a method sometimes termed information engineering, is a departure from the conventional structured approach to systems analysis. Structured analysis worked well when computer systems did nothing but automate manual methods. Analyzing requirements put the focus on the processes people use to do their jobs rather than on the data those processes manipulate. End users who performed the manual processes were indeed the best sources of information on how the system should perform. Today's systems, however, demand a primary emphasis on data.

Another vital ingredient of any software engineering plan is a well-conceived system of project management. At Comdisco Inc., the Rosemont, Ill., leasing company, the Information Systems Group purchased a packaged information engineering-based methodology, then held a three-day JAD session to customize it to Comdisco's needs. Comdisco calls the customized methodology Passport and has issued manuals and a shirt-pocket reference guide to support it.

Joseph L. Smith, director of applications development, is responsible for introducing the methodology at Comdisco. Smith's organization developed its own internal training team composed of senior information systems managers. Everyone in the department will be trained in both project management and the techniques relevant to their own function, according to Smith.

Although he is not ready to quantify them, Smith said he has "seen productivity gains in a short-term period" resulting from introduction of the project management guide. "When you talk about project management, you're talking about a framework to support all life-cycle phases," Smith said. "I call it DP-101. It's just good management."

Not every organization vests responsibility for project management in a single individual. At Beaumont Hospital's Information Services Center in Troy, Mich., project management is a team affair. "The team approach allows less-experienced people to grow more rapidly," said Paul S. Peabody, director of MIS and associate director of Beaumont Hospital. "[It allows them] to become more involved in all aspects of a given project rather than just in their particular responsibility."

The team functions as a group of peers, with all members equally responsible for the entire project and its deadlines. The typical life span of a project team is between six months and two years, Peabody said. When the project is over, team members are deployed to other project teams, taking with them a broader set of skills.

Formal project management is one of the "fundamental processes and principles" that apply regardless of an organization's size, said Margaret Tomczak, unit director in the Management Services Division at Eastman Kodak Co., in Rochester, N.Y. "No one is exempt from putting a plan together and following it," she said. "No one is exempt from talking about processes they will use to review their deliverables at various stages. And there is no excuse for not involving the customer throughout the life cycle."

One way of keeping customers involved is to present them with working prototypes of the system under development and ask for their reactions and recommendations. According to A. Milton Jenkins, professor of MIS at the University of Baltimore's Robert G. Merrick School of Business, prototyping works best when the system under develop-

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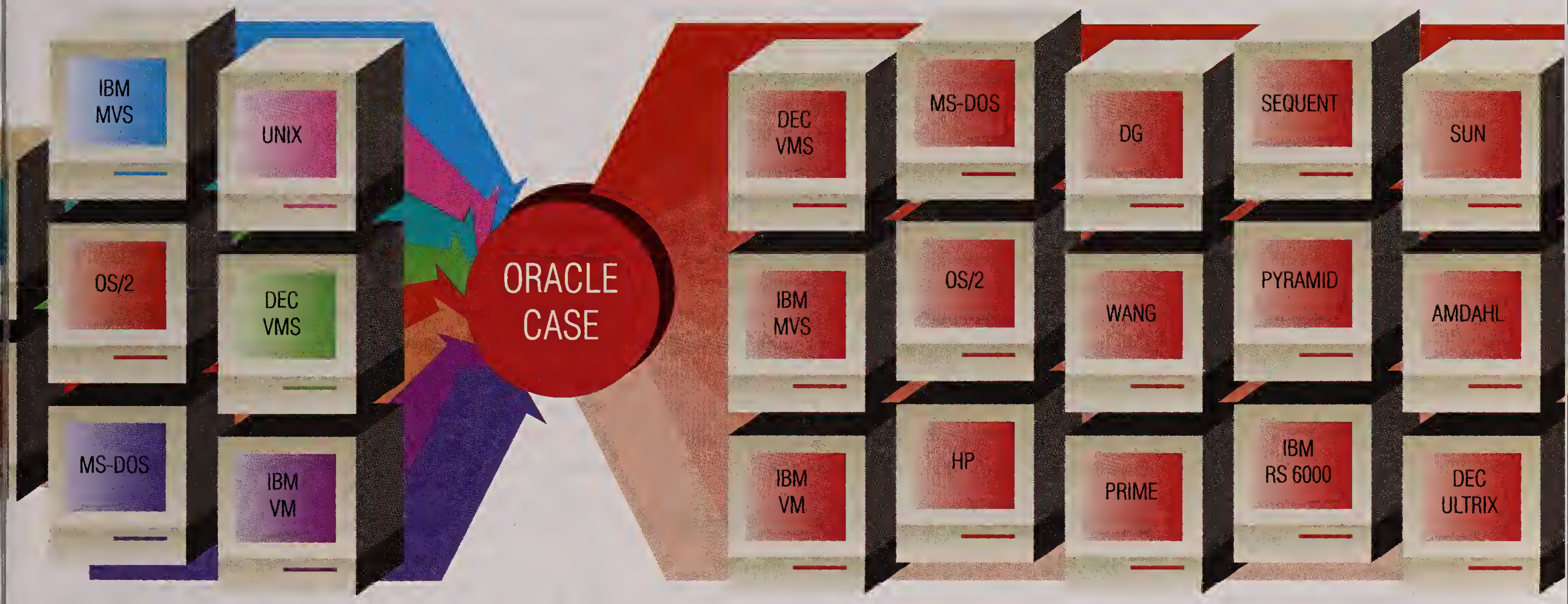

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ment is to be used for management planning or decision support. Such systems are smaller than conventional transaction-processing systems. They usually extract data from the corporate database and structure it in a way that is useful to an individual or small management or professional group. Increasingly, however, the technique is also applied to conventional transaction-processing systems.

Typically, prototypes are built using fourth generation languages and a relational database management system. "By exploiting this technology, one can increase productivity by a factor of 10 or more," Jenkins said. "Within two months a team of two persons can do what would take two workyears in the older technology.

"In prototyping," he added, "the user . . . really designs the system by determining what is adequate to meet [his or her] needs, which is different from the standard procedure in life-cycle methodologies."

As a necessary precondition to prototyping, data and software must be managed throughout the organization, Jenkins said. "If the data resources are not managed and consequently not accessible or reliable, then [prototyping] really doesn't make sense," he explained. "Managing the software means [being able] to take advantage of existing code in building prototypes."

1991 CIO SOFTWARE SURVEY

Tools that Improve Quality

Figures represent those tools and techniques cited most frequently

Large Companies	Mid-Sized Companies	Small Companies
4GLs 19%	**4GLs** 21%	**CASE** 14%
CASE 9	**CASE** 13	**4GLs** 11
Prototyping 7		**Joint Application Design** 11

Companies were also asked to quantify the quality improvement achieved using their most effective tool. The few small companies that responded reported the best results with CASE and joint application design (50% each) compared to 4GLs (27%). The few mid-sized companies that quantified improvement gave CASE 35% and 4GLs 30%.

Although a typical prototype goes through about four iterations before the user approves it, prototyping saves the development organization time and money, Jenkins said. "With prototyping you conserve the resource that is the scarcest and most expensive: the human resource." People who worry that prototyping will lead to a cycle of endless refinements "don't give the user credit for wanting to get the job done."

Far from being an extra step in the development life cycle, Jenkins said, in half of 194 instances he has studied, the prototype became the completed system. Another 42 percent of prototypes went on to provide the specifications for a larger system development activity. Only 8 percent of the prototypes were discarded, some because the effort revealed that the project was a bad idea, others because the prototype served a one-time purpose and was no longer needed.

One of the benefits of prototyping, according to Jenkins, is that it puts IS people into a more professional relationship with people on the business side. "Analysts begin to view users as real clients, much as an architect or doctor does," he said. Moreover, prototyping tends to create "system-smart users." They learn to consider the implications of making design changes, and "pretty soon the users sound more like analysts," Jenkins said. "They consider things they wouldn't have considered before."

Perhaps the greatest contribution to software quality and productivity will ultimately be made by building libraries of reusable code. Traditionally, development teams construct each new application from scratch, often writing code to perform routine tasks that are being carried out quite competently by applications already in use. The goal of reusability is to have one standard way of doing such things, with the code for it readily available to anyone who needs it.

One technique that many believe will advance the cause of reusability is object-oriented design. Bertrand Meyer, author of the object-oriented programming language Eiffel and president of Interactive Software Engineering in Goleta, Calif., describes object orientation as "a way of structuring software based on the objects that a software system manipulates instead of on the steps and functions that the system performs." He likened the creation of software objects to electronic design, where engineers work largely by recombining existing hardware components.

Even existing applications written in Cobol or another third generation language can be brought under the object-oriented umbrella, Meyer said. Code modules of proven quality can be abstracted and encapsulated in an object-oriented shell. "What is needed is not to rewrite everything," Meyer said, "but to repackage non-object-oriented code into object-oriented structures so as to be able to proceed with more advanced extensions or additions, leaving until later the question of whether to rewrite the repackaged elements."

"Object orientation doesn't have to be an all-or-nothing proposition," said Software Development Concept's Ward. "There's no reason why, when you are making a significant maintenance change, you can't carve out a piece and restructure it in object-oriented terms, then extend the boundary the next time, and so on."

Efforts at software quality, however well-intentioned, mean little unless they are accompanied by a system of measurements. Kuznicki's work at USAA, a property and casualty insurance company, includes establishing a system that measures product quality. Measurement, Kuznicki pointed out, should take place in the context of an organization's software inventory. That means not only knowing what applications the organization maintains, but also having some way of measuring the size of those applications.

One measurement that is rapidly gaining acceptance is known as function points (See Trendlines, Page 14). First proposed in 1983 by A.J. Albrecht at IBM, function points count the number of unique inputs and outputs, logical files and reports handled by an application. IS productivity can be measured in terms of function points produced or maintained per workmonth.

According to Eugene F. Bedell, formerly chief information officer at The First Boston Corp. and now president and CEO of SEER Technologies Inc. (a New York-based joint venture of First Boston and IBM that develops software tools and applications for the securities industry), programmers using a third generation language such as Cobol will produce between three and five function points per month. With a 4GL, productivity typically increases to between five and seven function points per month. Use of an automated code generator can yield 16 function points per month, not considering the possibility of generating reusable code, in which case the number of function points soars to an estimated 64 per month.

Kuznicki measures defects in relation to the number of function points in his organization's software inventory. If the ratio of defects to function points decreases, then quality is improving even if the raw number of defects has increased, he pointed out. On the other hand, if the number of function points produced per person in a month increases but the defect ratio also increases, then increased productivity is having a negative effect on quality.

But measurement is useless unless someone is looking at the results, Kuznicki warned. That doesn't mean using metrics to compare one individual's output to that of another, but it may mean using them to evaluate the improvement in a manager's performance over time. "There is a tendency to want to compare one person to another," Kuznicki said, "but it's more important that people should be making progress with their own mission and resources.

"What you really have to do to make a measurement program successful is to communicate downward throughout the organization that someone is going to be monitoring progress," he said. "Somebody has to be using the data."

When function points were introduced at Kodak, Tomczak obtained a written commitment from management that they would never be used in individual performance appraisals. Still, some people objected that function points did not take into account the complexity of the systems they were building. "We tried to show people that this wasn't about credit," she said, "just about measuring progress and understanding what works and what doesn't."

While none of these techniques has been in use long enough to amass a substantial body of statistics, early results suggest the game is well worth the candle. Tomczak saw a 10 percent development productivity increase in the first year after implementing software engineering techniques. Smith said the ratio of new development to maintenance has changed drastically in his department. Currently, about 70 percent of all IS activity is focused on new applications, and only 30 percent is spent on maintenance and programming fixes—an allocation of resources roughly the reverse of that found in most IS departments.

Mickey Williamson heads the Qwerty Group and edits the newsletter CASE Strategies.

> **"What you really have to do to make a measurement program successful is to communicate downward throughout the organization that someone is going to be monitoring progress."**
>
> *–Ronald J. Kuznicki*

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LEVERAGING TOOLS

Close, but no Veg-O-Matic

CASE and other tools are solving important pieces of the overall development puzzle, but users still wait for that fabled full-life-cycle solution that does it all

BY DAVID FREEDMAN

Well, we're into a new decade, and CIOs still routinely name their inability to develop the right software fast enough as their biggest problem. But, wait a minute—wasn't computer-aided software engineering (CASE) supposed to take care of this situation five years ago? For that matter, weren't fourth generation languages (4GLs) supposed to solve everything 15 years ago?

The tool that will provide the ultimate solution to the difficulties of software development hasn't arrived, and perhaps it never will. But what's out there today has also gotten something of a bad rap. Few managers spend time moaning about the failure of 4GLs to revolutionize software development; they're too busy using them productively in a variety of applications. CASE tools also seem to be settling in as useful weapons capable of winning important battles—but not the war. "In general there's a fairly massive degree of disappointment with the whole business of CASE," said Vaughan Merlyn, a partner with Ernst & Young's Center for Information Technology and Strategy in Boston. "But tools aren't really the issue. What's missing are the right skills and methods with which to apply them."

Still, some IT managers have given a lot of thought to where CASE and its cousins miss the boat. Ideally a CASE tool wouldn't be complete unless, as A. Earl Hoskins, director of product management at CASE vendor Index Technology Corp. in Cambridge, Mass., said, "you could take business requirements, put them in a black box and get code out the other end." More realistically managers would like to see as much of the development process as possible automated, from pinning down business requirements to

DEAN MULLER *was disappointed in his search for a tool that would allow the seamless automation of his department's chosen methodology.*

PHOTO BY NEIL MACDONALD

generating code.

Increasingly IS managers fault current tools for their inability to assert themselves over the entire process. "I view the current software development environment as being like the pre-Ford era of automobiles," said Dean Muller, director of software engineering and development support for Whirlpool Corp. in Benton Harbor, Mich. "We're still trying to be effective by dealing with separate pieces instead of reworking everything into a single framework."

After Muller's department focused on a particular software development methodology a few years ago, he started looking for a set of tools that would "help move us from a job-shop approach to an engineering approach." He found tools that helped with every stage of the process—but nothing that would allow the seamless automation of the entire methodology his department had selected. Some tools actually offered the worst of both worlds: They were integrated in a way that provided little value but that excluded adding other components that might better fit the methodology.

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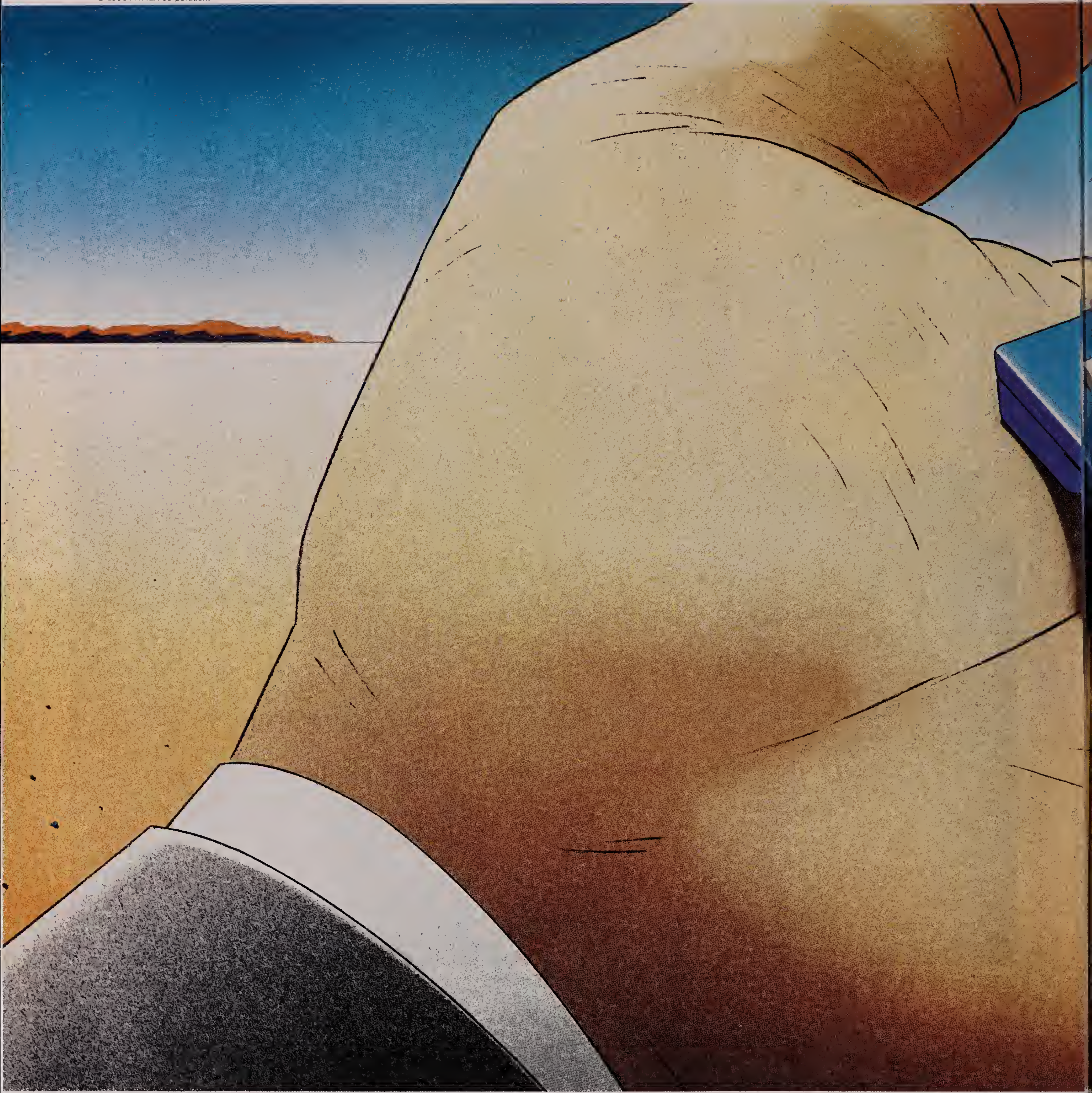

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Since he couldn't have the integration, Muller focused on tools that did the most with the planning and analysis stages of software development. "Those are the key areas where you can make major strides today because there isn't a lot of discipline in them," he explained. "When it comes to lower levels of design and code generation, you get into a lot of religious wars." Ultimately, Muller settled on CASE tools from KnowledgeWare Inc. in Atlanta. Although they lack full integration, he said, the tools are a good first step: "Just because we're not ready to build an entire car on an assembly line doesn't mean we're not ready to at least build an engine on an assembly line."

> **"I view the current software development environment as being like the pre-Ford era of automobiles. We're . . . dealing with separate pieces instead of reworking everything into a single framework."** *–Dean Muller*

Still, Muller warned of an illusory aspect to the improvements that emerge from a component approach to automating software development. Companies try to gauge the value of individual tools by examining how they affect one stage of the process instead of their impact on providing systems that meet the business' needs. "Improving one aspect of software development could negatively affect another aspect," he said. "A particular prototyping tool may allow getting user specifications more clearly and quickly, but it could also slow down the process of designing executable code. When we measure productivity, it should be across the entire life cycle of software."

Others echo Muller's disappointment. "We quickly found out that vendors' claims for integrated tools were marketing jargon," growled Harry Wallaesa, vice president of management information systems for Campbell Soup Co. in Camden, N.J. Wallaesa bemoaned the lack of close links between tools that address the software design process and those that automatically generate code. "It's a critical gap," he said. "The tools we've used have been fabulous at what they're intended for, but we're hoping to get something that will do a better job at taking us all the way through."

Wallaesa's department has provided some of the missing integration among tools by weaving them more tightly into its method-

More From the Wish List

Full-life-cycle tools aren't all that's on users' minds

The loudest demand of IS managers may be for better integration of existing software development tools over the full development life cycle. But that's not all they want. Here's a look at some of the runners-up on managers' software development-tool wish list:

Workgroup-Oriented Tools: When was the last time you formed a one-person software development team? At Eastman Kodak's distribution division in Rochester, N.Y., the smallest development team consists of six people, and one project currently employs 30. That's why the division turned to DesignAid, from Transform Logic in Scottsdale, Ariz. DesignAid is one of the few tools on the market that runs on a LAN to instantly apprise each team member of changes made by another member. "It makes an enormous difference," said Eastman Kodak Systems Analyst Chris Thornton, who is in charge of CASE for the information systems department in the distribution division. "Before we had the workgroup capabilities we were having trouble getting people to buy into CASE, and we were never able to use the tools to take a project from start to completion. Now we have 70 people using DesignAid on a LAN, and we're going to finish our first major project with CASE."

Reverse Engineering: When is someone going to do something really good for the people who worry about the high cost of maintenance? Pretty soon, according to several vendors. Index Technology Corp. of Cambridge, Mass., has already introduced a "design recovery" addition to its basket of development tools that it claims can convert an existing Cobol program into a logical representation that can be easily modified. Bachman Information Systems Inc. of Cambridge does the same sort of thing with databases. Most CASE vendors say they're working on similar features.

Templates: Said Harry Wallaesa, vice president of management information systems for Campbell Soup Co. in Camden, N.J., "We'd install a package before developing custom code every time." Unfortunately, Wallaesa noted, even customizable packages can't always be fit to the company's specific needs. But some vendors may be coming up with an interesting alternative: CASE tools that have much of the design, code and data structures

HARRY WALLAESA *compensates for the lack of integrated tools by developing stronger links among people in IS.*

PHOTO BY EUGENE MOPSIK

"We quickly found out that vendors' claims for integrated tools were marketing jargon."

–Harry Wallaesa

needed for a particular application already built in. The tools would then allow customizing the system at a high level and adding in whatever code and data are required. Arthur Andersen, in Chicago, already offers a customer-information-system version of such a CASE-based template application aimed at utilities, and has plans to bring out versions for other applications and markets. If that approach catches on, application-software vendors will have to play the same game. Said Pete Privateer, director of product programs for KnowledgeWare Inc. in Atlanta: "By the mid-'90s, no packaged-software vendor will deliver source or object code. The Computer Associates and Dun & Bradstreets will all be delivering models that can be tailored by CASE tools."

Reusable Code: Many vendors claim their products will eventually bring customers closer to the dream of setting up a library of program modules that can be mixed and matched to build any application. But IS managers aren't holding their breath. The problem: Everyone's code is incompatible with everyone else's. "The science of reusable code won't progress until key standards and models get defined for reuse," said Dean Muller, director of software engineering and development support for Whirlpool Corp. in Benton Harbor, Mich. "But at least we have fewer different directions in the industry now, and the standards set by IBM, Digital, Computer Associates and others are starting to look more similar than they did five years ago."

Object-Oriented Everything: Everyone is talking about objects, which are modules of combined code and data that can be manipulated as one piece. Modules of object-oriented programs or databases can be more easily mixed and matched than their traditional counterparts, though it isn't necessarily easier (and right now is probably a lot harder) to build them in the first place. Vendors aren't doing much with the concept yet, but they seem to like it. "Object-oriented design and analysis is a more natural way of looking at the world, and in three to five years it will be the dominant technique," said KnowledgeWare's Privateer. However, Vaughan Merlyn, a partner with Ernst & Young's Center for Information Technology and Strategy in Boston, isn't so sure about the importance of object-oriented efforts. "It's just the latest fad," he asserted. "Those looking to object-oriented programming as the answer will be just as disappointed as they were by every other concept that was supposed to solve our problems. How many times do we have to go through this?" Probably a lot.

–D. Freedman

ology. Besides, he added, IS departments should not wait for vendors to solve the integration problem; significant productivity gains can be had by developing stronger links among people in IS. "System development is no longer a separate kingdom here," he said. "We're seeing better cooperation between development, database administration, technical services, end-user computing and telecommunications. By introducing this sort of cross-functional team approach, we can get productivity improvements that we could never get from tools alone."

1991 CIO SOFTWARE SURVEY

Tools that Reduce Turnaround Time

Figures represent those tools and techniques cited most frequently

Large Companies	Mid-Sized Companies	Small Companies
4GLs 22%	4GLs 26%	4GLs 30%
Prototyping 12	CASE 10	Prototyping 19
	Prototyping 8	Reusable Code 11

Companies were also asked to quantify the time reduction achieved using their most effective tool. Of the few that responded, mid-sized companies reported almost identical reductions using 4GLs (41%) and CASE (40%), while small companies had the most success with prototyping (53%).

That's a variation on a theme that Ernst & Young's Merlyn has been pounding away at for some time. "The industry continues to look for new miracles, but they don't do the basics," he complained. "After you stabilize your processes, and after you create an environment where you can manage improvement of these processes, only then does it make sense to evaluate tools and try to apply them effectively." But even companies adept at the basics are finding that existing tools provide only spotty coverage of the development life cycle, Merlyn conceded. In particular, he said, tools lack process-management features to step analysts through the development process, invoking the appropriate tools along the way and enforcing methodology and quality standards.

"Today all the tools are individual components that come from the middle of the development cycle," he said. "Why aren't more complete tools available? Because the market hasn't been demanding them."

But things are improving: IT managers are beginning to ask for full-life-cycle tools, and vendors seem to be getting the message. Many observers have high hopes for IBM's AD/Cycle strategy—an attempt to standardize the development process around a central repository of information about the structure of a company's programs and databases. "It's not that AD/Cycle is a particularly good product," said Whirlpool's Muller, "but it focuses attention on the fact that there has to be complete interoperability among all the components of the life cycle."

IBM itself has been relying on partnerships with CASE software vendors to fill out its AD/Cycle product line, including one with Index Technology, long viewed as a component-oriented tool vendor. Index's Hoskins claimed that the AD/Cycle repository reduces the differences between a fully integrated development tool and a series of components. "AD/Cycle stores information from different components with a common interface, so you can mix the tools you use," he said. In addition Index will be announcing an integrated code generator that will bring the company's toolset closer to the mythical black box. "If you move the generation of the application closer to the analysis stage before you've spent a lot of time worrying about the physical design, then you can have it done by people more familiar with the business rules," he said.

A few vendors can legitimately claim they've been pushing the benefits of an integrated life-cycle approach from the beginning. Texas Instruments Inc. (TI) in Dallas introduced the Information Engineering Facility (IEF) some six years ago in an attempt to automate the development process from analysis through code generation. Besides claiming that the product can automatically produce 100 percent of an application's code, Director of IEF Worldwide Sales and Marketing Larry Howard said that the key to IEF's effectiveness is its ability to generate the code from the information that emerges from the analysis and planning modules.

IEF user Phil Kunz, manager of software engineering at Sony Corp. of America in

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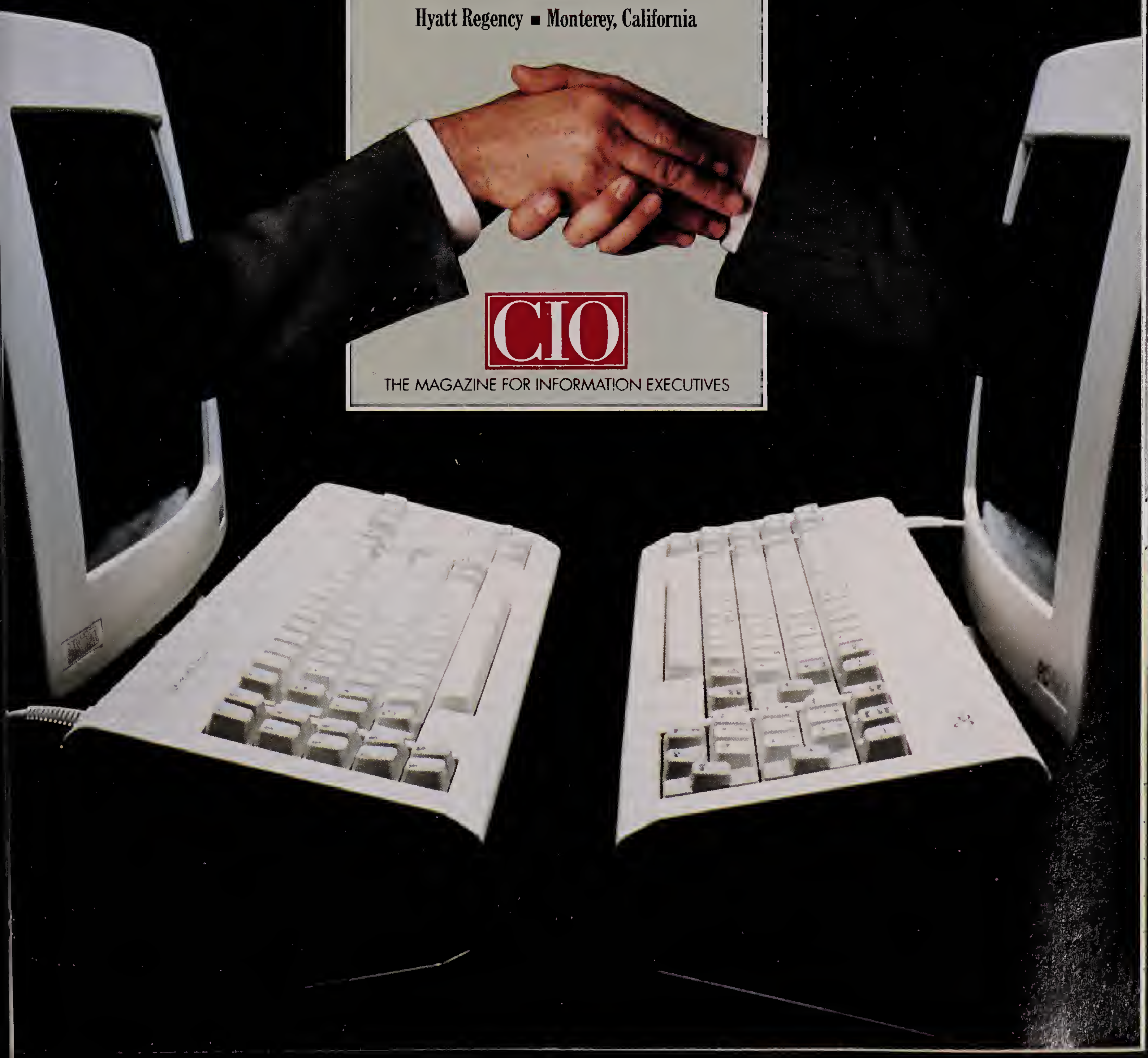

CIO

THE MAGAZINE FOR INFORMATION EXECUTIVES

Even companies that have covered the basics are finding that existing tools provide only spotty coverage of the development life cycle.

VAUGHAN MERLYN: *"In general there's a fairly massive degree of disappointment with the whole business of CASE."*

Park Ridge, N.J., agrees that the degree of integration of the code generation with the other components was the software's most attractive feature. "We know how to code," he said. "The question for us was, 'What do we code?' " Kunz also feared that mixing and matching components would lead to vendor finger-pointing. "We didn't relish the idea of one vendor saying, 'It's not my fault; the problem is upstream or downstream in the process.' " At $300,000 to $400,000 the TI product isn't cheap: But a LAN version slated for introduction this year should bring the price below $100,000.

Arthur Andersen's Foundation product has also been moving quickly to a more integrated approach. "We're trying to evolve our tools into the area of process management," said Michael Hudson, director of Foundation product planning and marketing at Andersen Consulting's Chicago office. "We'd like to get to the point where the methodology itself becomes automated and manages the process. You would enter into the development environment through the methodology tools, and they would call the various design tools as you progressed. Today the methodology is passive relative to the development tools, and we want to make the methodology an active part of the process."

Vendors aren't the only ones who claim they are changing; IT managers say they are ready to meet them at least halfway. Mary-Jane Monks, an AT&T corporate technical education consultant in charge of smoothing the transition to CASE for the company's 2,000-odd developers, noted that the increasing integration of tools will require consolidating the skills of development staff to match. "Pretty soon we're going to start seeing a real shift in emphasis,

PHOTO BY GEORGE SIMIAN

where the physical design and coding of programs will be de-emphasized as the quality of tools improves," said Monks, who is based in Piscataway, N.J. "The coder and physical designer will become more or less obsolete for business applications, but analysis and logical design skills will have to be greatly emphasized. In particular, the analyst will have to develop more skill in dealing with business clients, because the tools will force analysts to be more precise in spelling out the business requirements."

> **"The coder and physical designer will become more or less obsolete for business applications, but analysis and logical design skills will have to be greatly emphasized."**
>
> *–Mary-Jane Monks*

Monks worked closely with one of AT&T's key CASE vendors, Bachman Information Systems Inc. of Cambridge, Mass., to ensure the best possible fit between tools and developers. In some cases, Bachman modified its tools to meet AT&T's needs—no easy feat. "We have a huge range of projects, from massive billing systems to engineering systems that maintain the network," said Monks. "When we brought our requirements to CASE vendors, we'd blow their minds."

But the demands of CASE are typically more overwhelming to the company trying to move to it than to the vendor selling it. Deutsche Credit Corp., a financial-services company in Deerfield, Ill., turned to Index Technology's Excelerator last year to help deal with an enormous development burden. In addition to building entirely new systems for retail and commercial business, Deutsche also undertook the rebuilding and integration of all of its 11-year-old systems. Executive Vice President and Chief Operating Officer L. Gerald Campeau said he expects Excelerator to help, but so far the ongoing demands of development have allowed no time to get fully up-to-speed on the CASE tools. "It's a question of timing," explained Campeau. "We know where we need to be with CASE, but at the same time we need to keep the business going. It would be ideal to put four or five people aside, but right now we can't."

1991 CIO SOFTWARE SURVEY

Overcoming Barriers to Productivity

Figures indicate percentage of respondents saying this was one of the five most important software development tools or techniques they are using to improve quality and reduce turnaround time.

TOOL OR TECHNIQUE	
Fourth generation languages	62%
CASE	34
Prototyping	34
Reusable code	32
Project management software	25
Code generators	23
Joint application design	22
Templates	17
Outsourcing system development	11
Packaged methodology (e.g., Information Engineering, Foundation)	7
Rapid application development	5
Repositories	5
Other*	42

* *Includes packaged software, database management software, data dictionaries, report writers, debugging, establishing standards, PC integration, rapid prototyping, SQL, structured methodology and testing tools/analyzers*

The overwhelming majority of those listing one of the "other" tools were mid-sized companies.

Clearly, vendors can't be blamed for a company's inability to make time to adapt to its tools. In fact, it's not clear that vendors can be blamed for anything, except perhaps for not anticipating the demand for better-integrated, cross-life-cycle products. But that's a demand that IS managers themselves began voicing only relatively recently—and one that seems likely to be met over the next few years. Now, if only vendors could figure out what CIOs will be screaming for in 1995.

David Freedman is a freelance writer based in Brookline, Mass.

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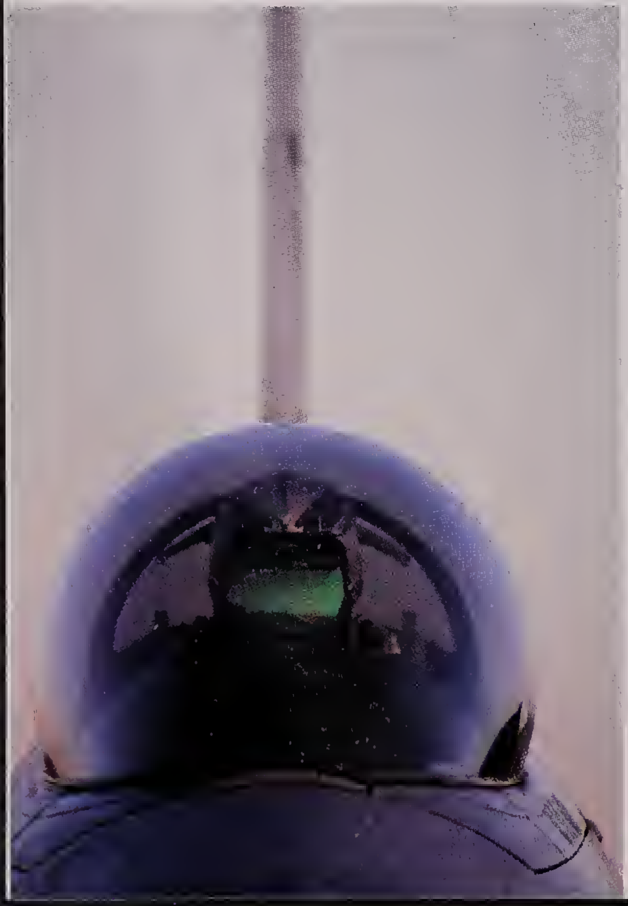

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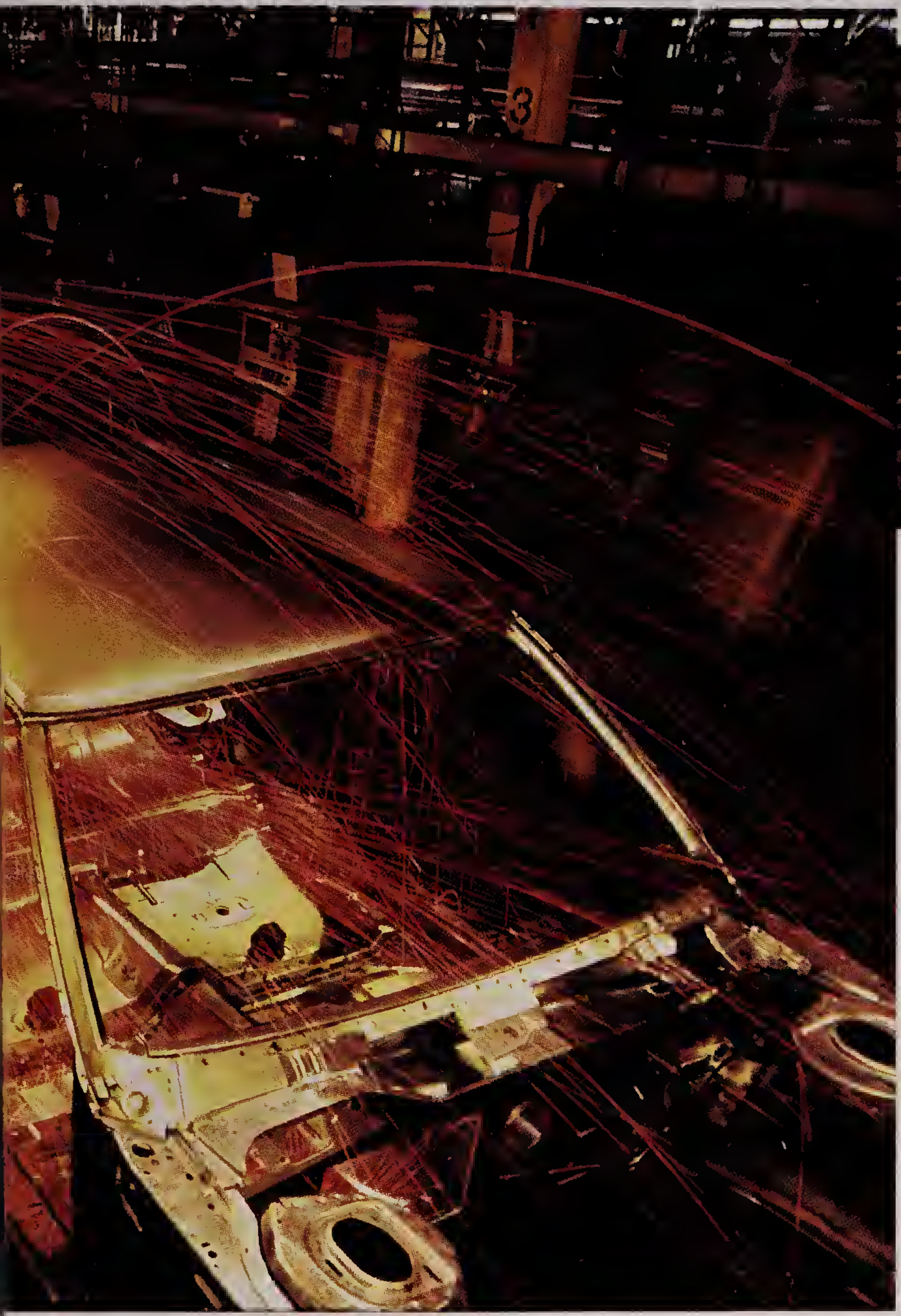

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MANAGING MAINTENANCE

The 4,000-Pound Gorilla

You can't make it go away. You can't completely subdue it. And you can't under any circumstances ignore it. Still, an increasing variety of tools and tactics can help keep the software maintenance burden from running amok.

BY KATHLEEN MELYMUKA

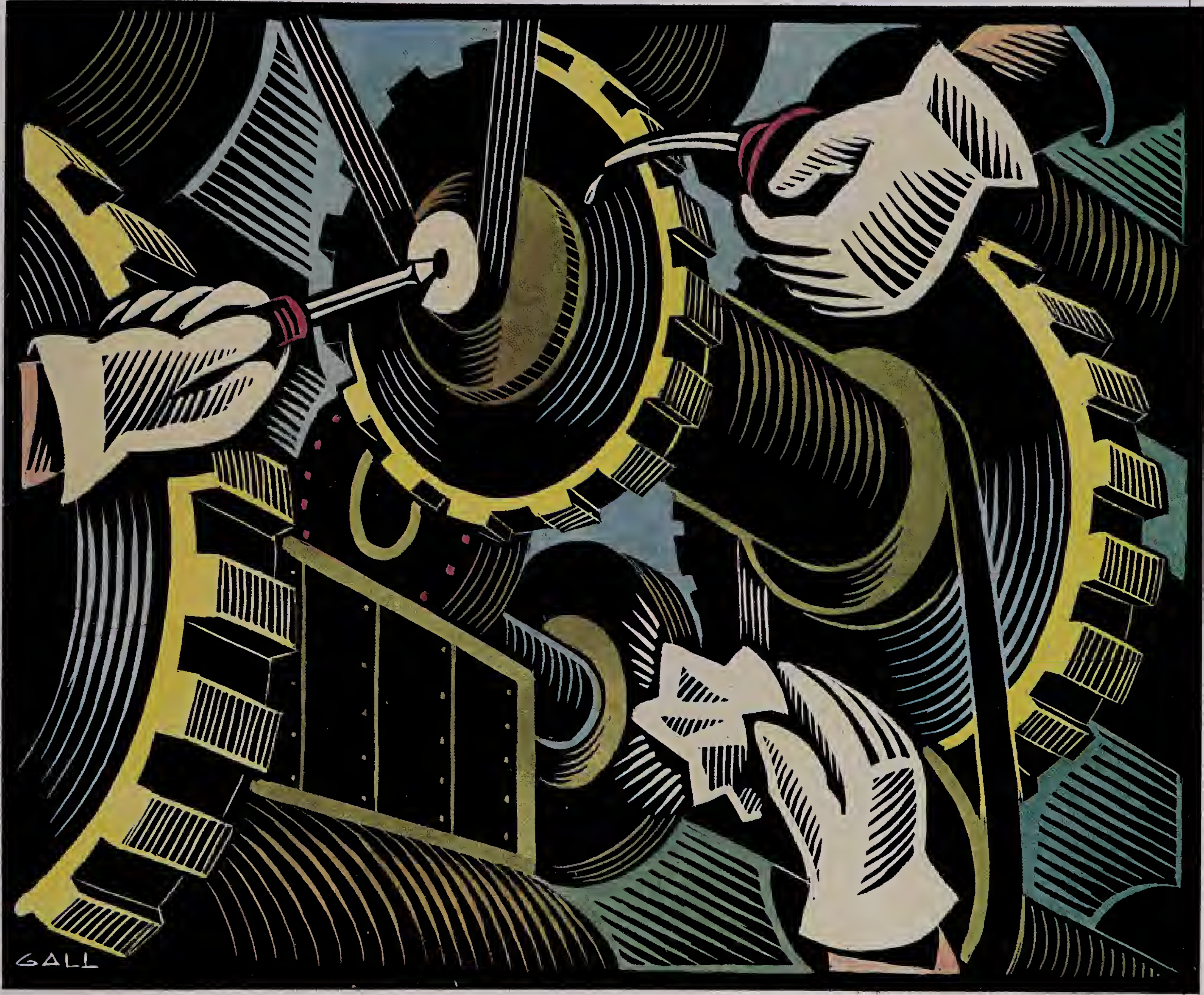
Software maintenance may sound like a yawn, but it's one of the biggest challenges information executives face. Unless CIOs get a handle on maintenance, they may not have the resources to do anything else.

Maintenance is more than exterminating bugs in a system. "It's anything we do to a system after it goes into production mode," according to Carma McClure, vice president of research for Extended Intelligence Inc., a Chicago consulting firm specializing in software automation.

Maintenance includes responding to new user needs, improving design or performance, adding features, porting to a different operating system, interfacing with new programs and upgrading technology (for example, moving from a flat file to a DBMS or from batch to interactive or downsizing from mainframe to PC).

The average age of a business system is 6½ years, with 25 percent more than 10 years old. There are an estimated 80 billion to 100 billion lines of Cobol code being maintained worldwide today. IBM estimates that $30 billion is spent each year on maintenance ($10 billion in the U.S.), with 50 percent of most data-processing budgets and 50 to 80 percent of the working hours of an estimated 1 million programmers being spent on maintenance.

The need for maintenance is growing every day. According to VIASOFT Inc., a Phoenix maker of computer-aided software



engineering (CASE) tools for maintenance, the average Fortune 100 company maintains 35 million lines of code and adds 3.5 million new lines a year just in enhancements, updates and other maintenance. That doesn't count new development.

Despite the size of the maintenance burden—or perhaps because of it—CIOs have been loath to invest in automated maintenance tools that have become available in the past five years. "CIOs are somewhat aware of [these tools], but some don't want to spend the effort or time on maintenance," said McClure. "They want to forge ahead on new development."

But the more than $2 trillion investment in existing software is a lot to throw away, McClure said, and anyway, it takes three to five years to develop most new systems. "Meanwhile, why do they want to spend 30 percent more on maintenance than they have to?"

"New development is perceived as more strategic," said Eric Bush, president of Language Technology Inc. (LTI) of Salem, Mass., a leading vendor of maintenance tools. "[CIOs] think of maintenance like taxes: It's always there, but there's not much you can do about it."

That's where they're wrong. "This topic area is about to explode because people are beginning to realize what's available," said McClure.

What's available includes analyzing tools to expose the strong and weak points of systems and restructuring tools to clean up old Cobol. Reverse-engineering tools on the horizon will enable analysts to change software without ever touching code. Repository-based re-engineering systems are enabling CIOs to begin the migration to a unified CASE environment for maintenance as well as development.

At Pacific Bell, data restructuring exposed as many as 50 names for one data element.

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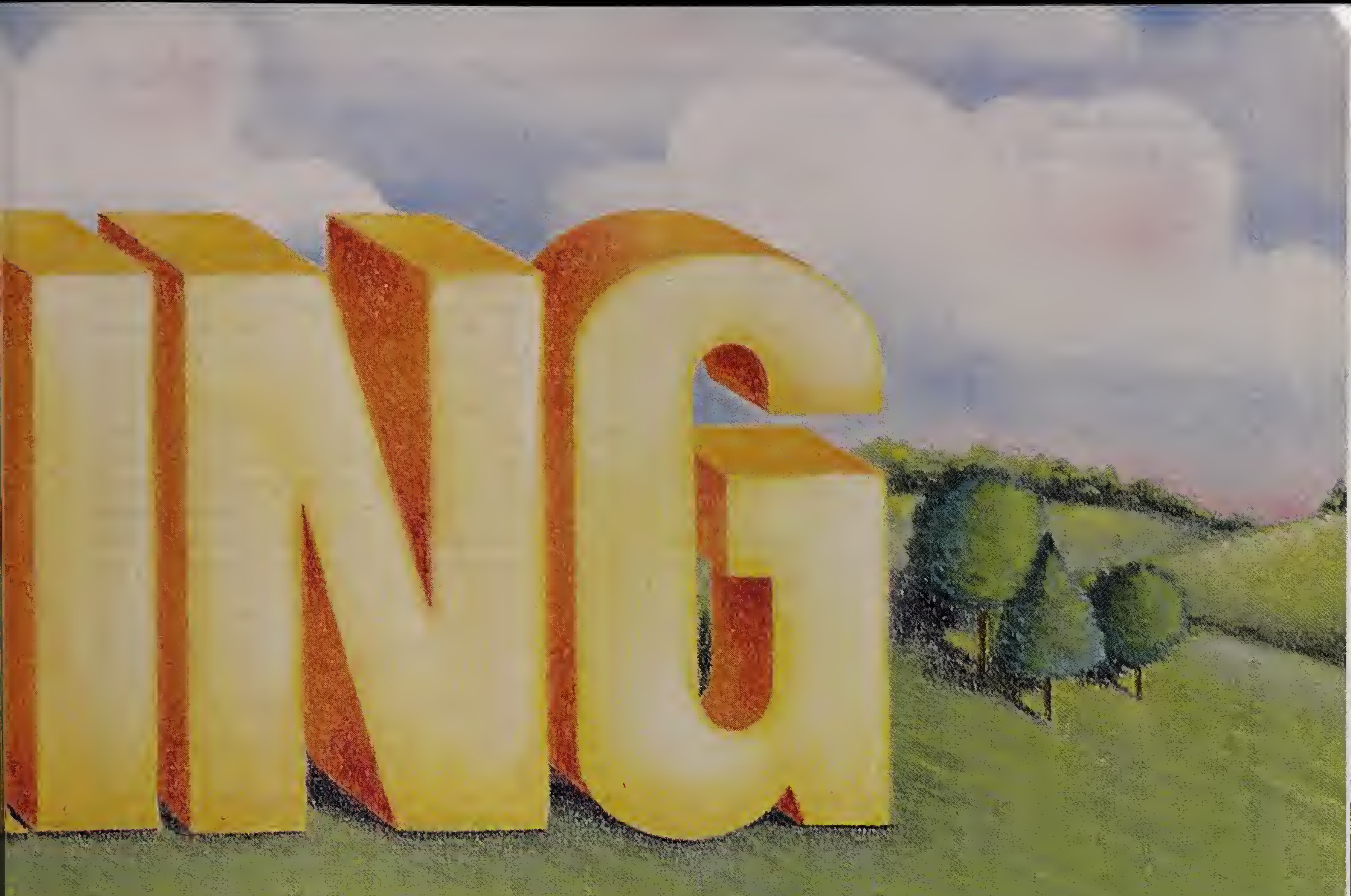

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> **"You have to give programmers tools they're comfortable with. If you don't, it's the kiss of death."**
>
> *–Frank Hanou*

"If you need to change a program, you have to understand what it's all about, see where to make the changes, understand the side effects of the changes, go ahead and make the changes, then test it," said McClure. "Understanding is the hardest."

Code analyzers help programmers understand the logic and examine the quality of code. "The quality [of code] can be so poor that you're throwing good money after bad [by patching it up]," explained Thomas J. McCabe Sr., president of McCabe & Associates, a Columbia, Md., pioneer in code analysis. Code analyzers, available from McCabe, XA Systems Corp. of Los Gatos, Calif.; Computer Data Systems Inc. (CDSI), of Rockville, Md.; LTI and others, provide mathematical measures to quantify such properties as structuredness and complexity. They test the quality of new code and help programmers decide whether old code should be fixed or tossed.

"[Analyzers] give you measures of how complicated the code is and what sort of strategy to take in terms of rewriting or throwing it out and starting over," said Eldonna (Elly) Williamson, an internal consultant for software improvement in the Newark, Del. office of E.I. du Pont de Nemours & Co. "They let you know rather than guess."

"We use [an analyzer] as a quality-assurance tool," said Patricia Seymour, staff manager for system renewal metrics and tool implementation at Pacific Bell of San Ramon, Calif. "Every time we touch code, we know if it's been improved or degraded. We also know when it's getting too complex."

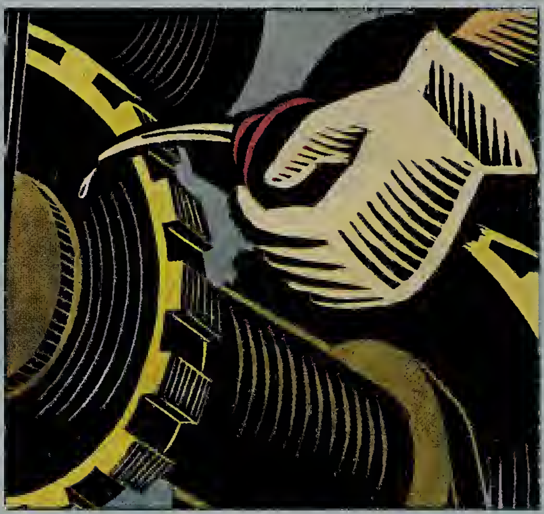
Restructuring tools, available from XA Systems, LTI, CDSI and others, bring order to the chaos of old Cobol. Some restructure a program's logic; others clarify data definitions. "Lots of programs have unnecessarily confusing logic from changes over the years or from having been written before there were good rules and conventions," McClure explained. "If you can standardize the form of a program, you reduce the number of logic paths through the program. You get the same function but a cleaner form."

Factoring the Human Equation

As crucial as they are, maintenance staff are frequently undervalued by the IS departments they support. Some companies are changing that.

Maintenance workers often complain that they're noticed only when things go wrong. The people at Frito-Lay Inc., of Dallas, and US WEST Communications, of Denver, have noticed that a little recognition goes a long way.

Two years ago, Frito-Lay began holding an annual symposium for maintenance workers, who go off-site to hear speakers and attend meetings and workshops covering developments in the industry.



"Maintenance folks are in the trenches on a day-to-day basis," said Frank Starkey, systems manager. "It's a day of recognition and appreciation for what they do."

The symposia have resulted in the establishment of a task force to share ideas, techniques and tools among maintenance groups in separate functional areas. The task force has already brought about changes that have increased the efficiency of maintenance.

US WEST Communications has a similar program. "A lot has to do with focus: treating them as professionals [and] recognizing their work as important," said Gerald J. Knutson, executive director of applications service. "We do a fair amount of recognition of the contributions of individual programmers. We let individuals talk about how they've applied techniques and tools and where they've seen benefits."

The company as a whole has benefited from the program, which began in 1988. At that time, 77 percent of enhancement projects were considered to be high-quality and on time by clients. The next year, 88 percent were so rated; last year, the number had reached 99 percent.

US WEST maintenance is performed by teams, said Knutson, and if a team exceeds its objective for the year, members get incremental bonuses. "We're at 166 percent of payout for this year. . . .

"People [are] taking ownership and wanting to do the best job they can," he said. "You have an investment in your people. I think that's the most important thing."

—K. Melymuka

Changes to code over the years can result in multiple definitions for the same objects, or data elements. Data restructurers assign standard data names and definitions to clarify meaning. The results can be astounding. At Pacific Bell, data restructuring exposed as many as 50 names for one data element.

Vendors say restructuring has both immediate and long-term benefits. "The goal is to get systems into a form where they can be maintained more easily and to get ready for what's coming," said Marc Fey, chairman and executive vice president for research and development at XA Systems Corp., referring to IBM's AD/Cycle. "Starting on those tasks today will give immediate [maintenance] benefits as well as position you for the long term."

The closest thing to a breakthrough in maintenance is the use of reverse-engineering tools to bring software into the CASE environment.

Users agree. "We've done a lot of code restructuring, and we've found it reduces the amount of expertise a programmer needs," said Seymour. "We can replace senior programmers with juniors and use subject-matter expertise in more valuable ways, such as defining new systems. It also cuts down on [training] time. If code all starts to look alike in format, new programmers can come up to speed more quickly."

There is a downside to restructuring. Restructured programs may be larger and take more time to execute. More important, programmers who "own" the old code may rebel.

A restructuring tool from CDSI addresses this problem. It's a graduated, 10-level program that enables users to choose how much restructuring they want to do. "Levels one through eight give the basic advantages of structuring but don't destroy ownership of the system," explained Frank Hanou, director and general manager of the software productivity tools division. "As you move up, more and more changes are made.

"If you're going to have tools used, you have to give [programmers] something

Preventive Maintenance

People would save themselves a lot of time, money and aggravation if only they'd get the system right the first time

"Most people are missing the boat on maintenance," said James C. Wetherbe, director of the Management Information Systems Research Center at the Carlson School, University of Minnesota at Minneapolis. "The reason they have to do so much is they're not getting the requirements right: what the system is supposed to do. It takes 50 to 100 times more time to make changes after the fact."

There are front-end and back-end solutions to problems, Wetherbe said, and more work on the front end would obviate the need for much of the maintenance done today.

Every system should begin with a cross-functional design, he believes. An inventory allocation system, for example, should be developed using input from the warehouse, sales, credit and shipping. "You need to talk with all of them together so the left hand knows what the right is doing," he explained. "Historically, developers interview managers individually. . . . It's more comfortable for them, . . . but you get a lot more input in less time with a group. You get perspectives out on the table at the same time."

The next obstacle to effective maintenance is that system designers ask users the wrong questions, Wetherbe said. For the inventory allocation system, for example, pertinent questions would include, "Why do you do order processing? What problems are you having? What decisions do you need to make? What is critical to your success? What would constitute effectiveness and efficiency?"

Another problem is that managers are often inflexible about costs. "You have to be flexible enough to get what you want," Wetherbe said. Otherwise, money saved up front will be more than lost down the line when users demand changes.

Designers should keep in mind that the software has to interface with other systems, he added. "Information architecture planning is like planning a freeway for a city. You don't just build streets and hope they all work out. The longer you build without integration, the harder it is to retrofit the pieces."

Finally, he said, if a prototype is built first, the resulting system will require far less maintenance than most. "There are lots of tools to fix the sins of the past," he said. "They're needed, but you should also quit sinning."

—K. Melymuka

they're comfortable with," Hanou warned. "If you don't, it's the kiss of death."

The closest thing to a breakthrough in maintenance is the use of reverse-engineering tools to bring software into the CASE environment, according to McClure. "People are beginning to do some [reverse engineering] now," she said. "It's not totally automated, but there are a lot of possibilities."

Forward engineering moves from requirements through analysis, design, coding, testing and operation: that is, from a higher level of abstraction to a lower, more concrete level, said Elliot Chikofsky, director of research and technology at Index Technology Corp. of Cambridge, Mass., a leading CASE toolmaker. Reverse engineering moves backward, starting from the concrete—software and documentation—and deriving abstractions. It asks, what does the system do? What business rules does it implement?

The rationale for reverse engineering, Chikofsky said, is that computer systems drive business. "If they're implementing rules that are not the real rules of the business, they're stifling the business," he said. "Reverse engineering enables you to figure out what the system says the business is doing and change it if you need to."

Reverse engineering can be aided by tools, but there's still a lot of human intervention and knowledge required, McClure

Taking the Bull by the Horns

Alarmed at the ever-widening maintenance spiral, ITT Hartford created a center devoted to application development

In 1984, Jack Crawford, vice president for information management at the ITT Hartford insurance company in Connecticut, projected the growth in maintenance at his company and determined that if things continued as they were going, by 1990 the whole IS staff would be doing nothing but maintenance.

Crawford's projections convinced top management to support the development of an application maintenance center, with a dedicated staff of 10 (each with at least 10 years' experience) and a five-year budget of $4 million.

The center was established in 1984-'85. At that time, there were no analysis tools on the market, so the center staff built one called Scoreboard and began a program to renovate software. "We set a process to identify systems that could benefit the most from restructuring and simplification," Crawford said. Of 35,000 programs in the corporate library, about 20,000 have been renovated so far. "Not all need it," Crawford noted.

There are two renovation processes. A "quick trip" is a fully automated overnight restructuring using Recoder from Language Technology Inc., of Salem, Mass. After restructuring, preliminary documentation is generated. Programmers add more as business changes are made.

A "full trip" is for more serious maintenance problems. The staff uses structure tree maps of large programs, generated by Recoder, to determine where to manually break them into smaller modules. "We want programs to have 300 lines or less," Crawford said. "Some written in the '70s have thousands." Documentation is added manually, and testing is extensive. About 1,100 of the worst programs have had full trips, according to Crawford.

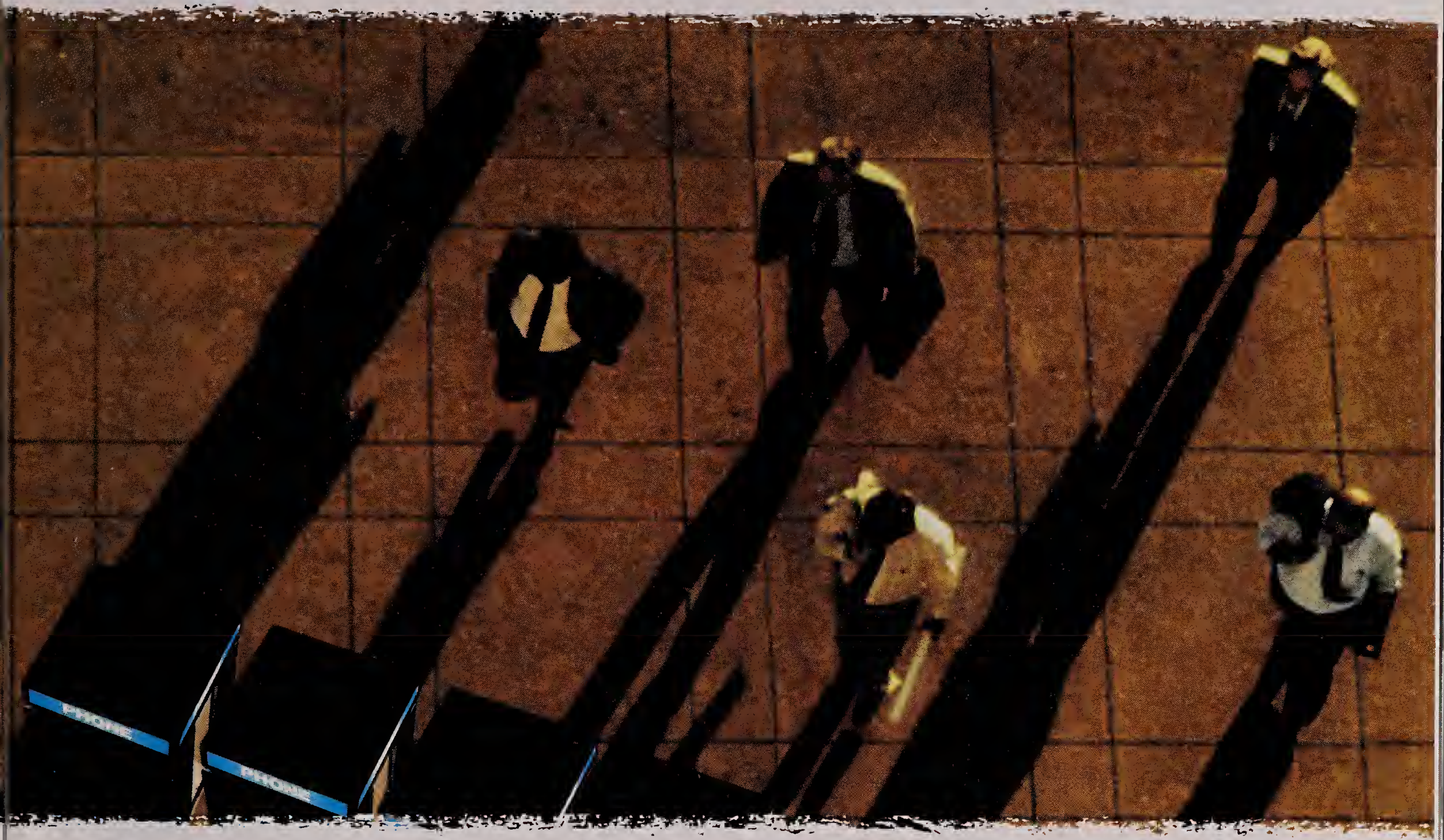
The center also designed a tool called PROBOL (for PROgrammer CoBOL analysis) to guide maintenance workers online through a complex system. "One business change might require changes to 10 programs," Crawford said. "Our studies found that 50 percent of the effort is determining where to make changes."

The benefits of the maintenance program are obvious. The number of maintenance staff has declined steadily since 1987. The number of executable lines of code maintained per person rose from about 26,000 lines in 1984 to 58,000 in 1989. In 1987, maintenance accounted for just under 30 percent of Crawford's total budget. By 1989, maintenance accounted for less than 25 percent of a total budget that had itself been reduced.

"I think we were fortunate to have had a view in the early '80s that there was a problem and to have made a commitment to do something about it," he said. "You have to [commit] the resources to make it happen."

—*K. Melymuka*

Out of the office not out of control.



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said. "This is relatively new. There are still some difficult problems to solve."

One of those tools is Excelerator for Design Recovery (EDR) from Index Technology. It assists programmers in moving backward from code to design specifications—the first step in reverse engineering.

Ian Smith, information management specialist at AT&T Long Distance Services in East Brunswick, N.J., used EDR to redocument an old system. "It gave us a physical model of what [each program] is doing," he said. "I save about 75 percent of the time it takes to capture the physical design of the code, but the major step is to translate what the software is physically doing to the intent of it. We're still light-years from that."

> **"Vendor products by and large do what they say they're going to do, but not many have the big picture of what it takes in the trenches."**
>
> *–Eldonna Williamson*

Still, the use of EDR will save about 20 to 25 percent of the entire reverse-engineering effort, Smith estimated.

Du Pont's Williamson, who has used a number of such products, agreed with Smith's assessment. "Vendor products by and large do what they say they're going to do, but not many have the big picture of what it takes in the trenches," she said. "Seventy-five percent of it is still manual."

For maintenance workers, backing up to the design level can have immense benefits. "If maintainers could work at the design-spec level rather than at the code level it would be much easier," said McClure.

LTI's Chrysalis, which is nearing completion, will enable maintainers to do that. Chrysalis will reverse-engineer Cobol code to extract original design specifications that it will display on the programmer's workstation in the form of diagrams for review or edit. Changes made to the diagrams will be forward engineered to the program. The programmer, said company president Bush, will be able to change programs by changing the diagrams, without touching the code.

A similar feat is expected in June when Bachman Information Systems Inc., of Burlington, Mass. begins shipping a product called Designer for CSP (IBM's Cross Systems Product), which is part of a product suite that will offer the ability to change a database by changing the English-like language in a high-level model of the database. "If your business requirements change, you enhance the model; you don't fix the program," said Chris Gane, principal consultant at Bachman. "It means you'll be able to maintain the model rather than the code."

Once systems are reverse engineered they can be maintained with CASE tools in a repository environment, which enables users to maintain data definitions in the repository and merely refer to them in the code. "Then you don't need to code definitions over and over," said Michael R. Heiberg, production manager of reverse engineering at CGI Systems Inc., of Pearl River, N.Y. "You define them once in the central database and refer to it."

This puts applications on a higher level of abstraction, thereby simplifying and clarifying them, said Robert H. Bouton, vice president for marketing at CGI Systems. "All data definitions are standard; you've got cross-references between applications. Now you've got a base for maintenance that is far superior, and you can also use it to go forward and build new applications."

Using CGI System's PACBASE, a repository-based development environment, one can "begin to re-engineer and use CASE techniques to make significant inroads in productivity and reuse information embedded in systems for new applications," Bouton said.

Renaissance, currently in beta test by VIASOFT Inc., is designed to break code by business function into reusable modules. "We want to be able to isolate a business rule and make a self-contained program to be put in the repository and reused in an old or new system," said Robert J. Lindsey, director of marketing communications.

Pacific Bell's Seymour is beta testing Renaissance to break large systems into modules. "It looks like it would work," she said. "Work that took us a week to do manually they were able to do in 10 minutes. But we haven't tested it yet."

With these and other tools currently available, CIOs can save a sizable chunk of their maintenance resources now (see related story, Page 79) while moving toward a unified CASE environment for the future. CIO

Kathleen Melymuka is a freelance writer based in Duxbury, Mass.

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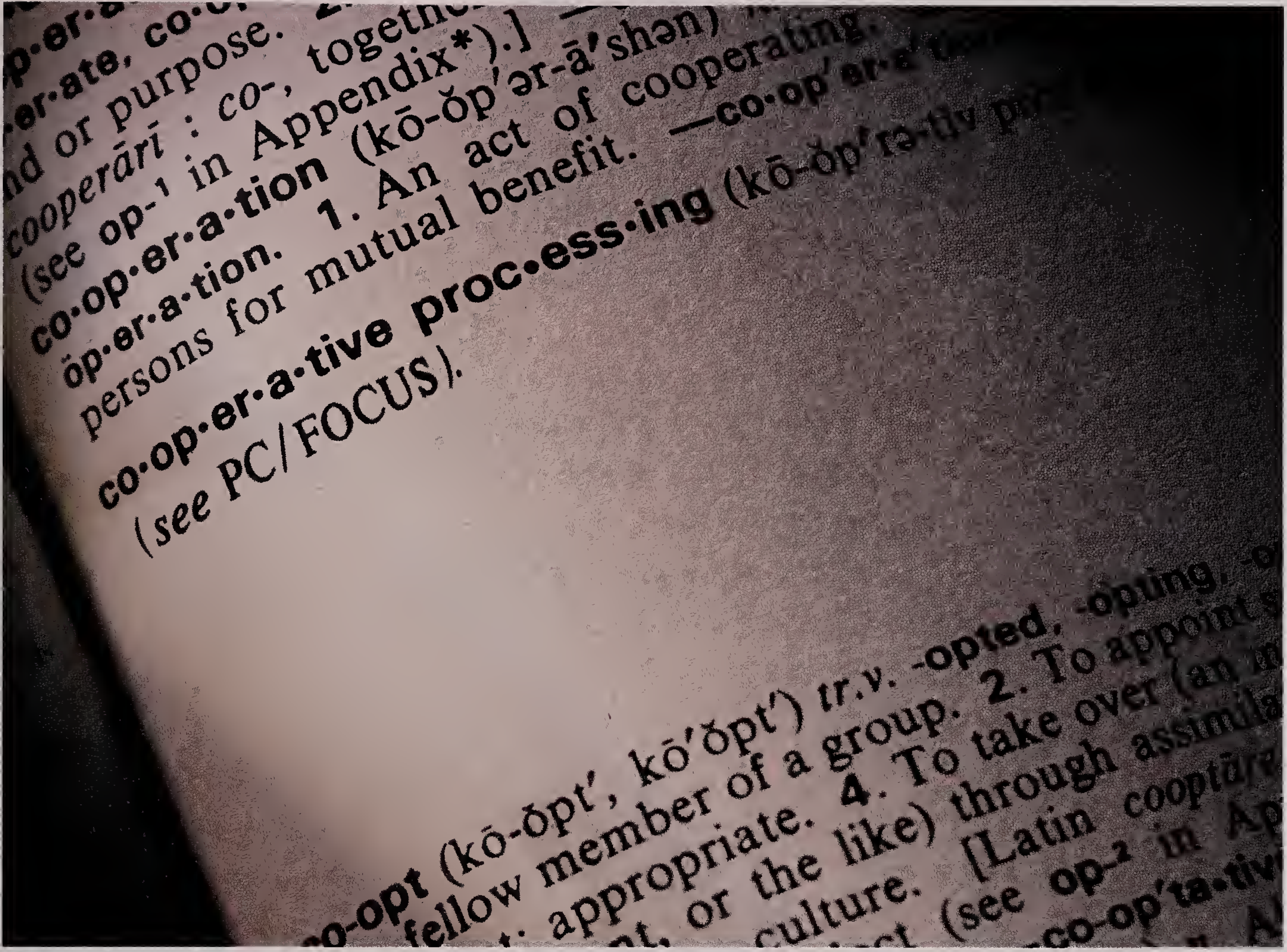
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I.S. RESISTANCE

Snatching Defeat from the Jaws of Victory

Defying all logic—and the promise of manifest benefits—the IS culture continues to clash with the very tools and tactics that could finally put its house in order

BY MICKEY WILLIAMSON

The votes are in and the verdict is clear: Certain practices, assembled in meaningful order and followed unfailingly, qualify an information systems organization to characterize its business as software engineering, as contrasted to software development. The difference is rigor—engineering-like precision and discipline in an undertaking most often thought of as a manifestation of the creative spirit.

The votes are in, the verdict clear, and the spirit most unwilling. It is no secret that many information systems professionals greet the harbinger of software engineering in their future with suspicion, if not sabotage, if not outright mutiny.

What's going on here? The information systems profession is notoriously self-selecting. People are drawn to it because they like to solve problems. Creative they may be; but they are supremely logical thinkers nonetheless. Surely they will welcome the challenge of mastering new tools and techniques and see the beauty in software engineering's inherent logic: that formal, describable, repeatable procedures lead to the development of software of superior quality by whatever measure, and consequently enhance the efficiency and effectiveness of the

KEN ORR: *IS organizations fail in instituting new methods because they don't change the underlying structures.*

PHOTO BY GEORGE SIMIAN

people who practice them.

Yet they resist change, as people have resisted change since the first cave dweller lit the first fire and somebody stomped it out. The reason is simple: Change causes discomfort, because it disrupts people's assumptions about the world that they inhabit. The only way that change becomes acceptable is if it causes less discomfort than adhering to the status quo. James W. Hunt, senior consultant at ODR Inc., an Atlanta firm specializing in change management, explained the phenomenon this way: "Pain drives change." Hunt told of a man who was working on an oil rig that exploded in the North Sea. The man jumped off the burning platform, 150 feet into an icy sea coated with burning oil. He jumped, the man later explained, because he knew that if he didn't, he would die.

The situation in most companies may not be as dramatic as a burning oil drilling rig, but the need to change is there nonetheless. It is up to the person closest to the heat, someone near the top of the organizational chart, to drive the acceptance of change down through the enterprise. When people resist, Hunt said, a manager has three options. "You can educate them, you can replace them, or you can prepare to fail." A crucial precursor to successful change is the creation of a culture that rewards the desired new behavior.

IS organizations fail in instituting new methods because "they are only partially serious," said Ken Orr, development methodologist and founder of The Ken Orr Institute, of Topeka, Kan. "They don't change the underlying structures. If you tell people you want them to take more time in front-end analysis and design, but you don't give them more time or prepare them for the psychological problems of doing more front-end work, then the real system of management, feedback and control will make people want to go back to the old ways."

Resistance to change may be active or passive, but it is always present when change is in the air, said Joseph L. Smith, director of applications development at Comdisco Inc., a high-tech leasing company in Rosemont, Ill. Gradually, resistance gives

JOSEPH L. SMITH: *Management must address head-on the possibility that mistakes will be made.*

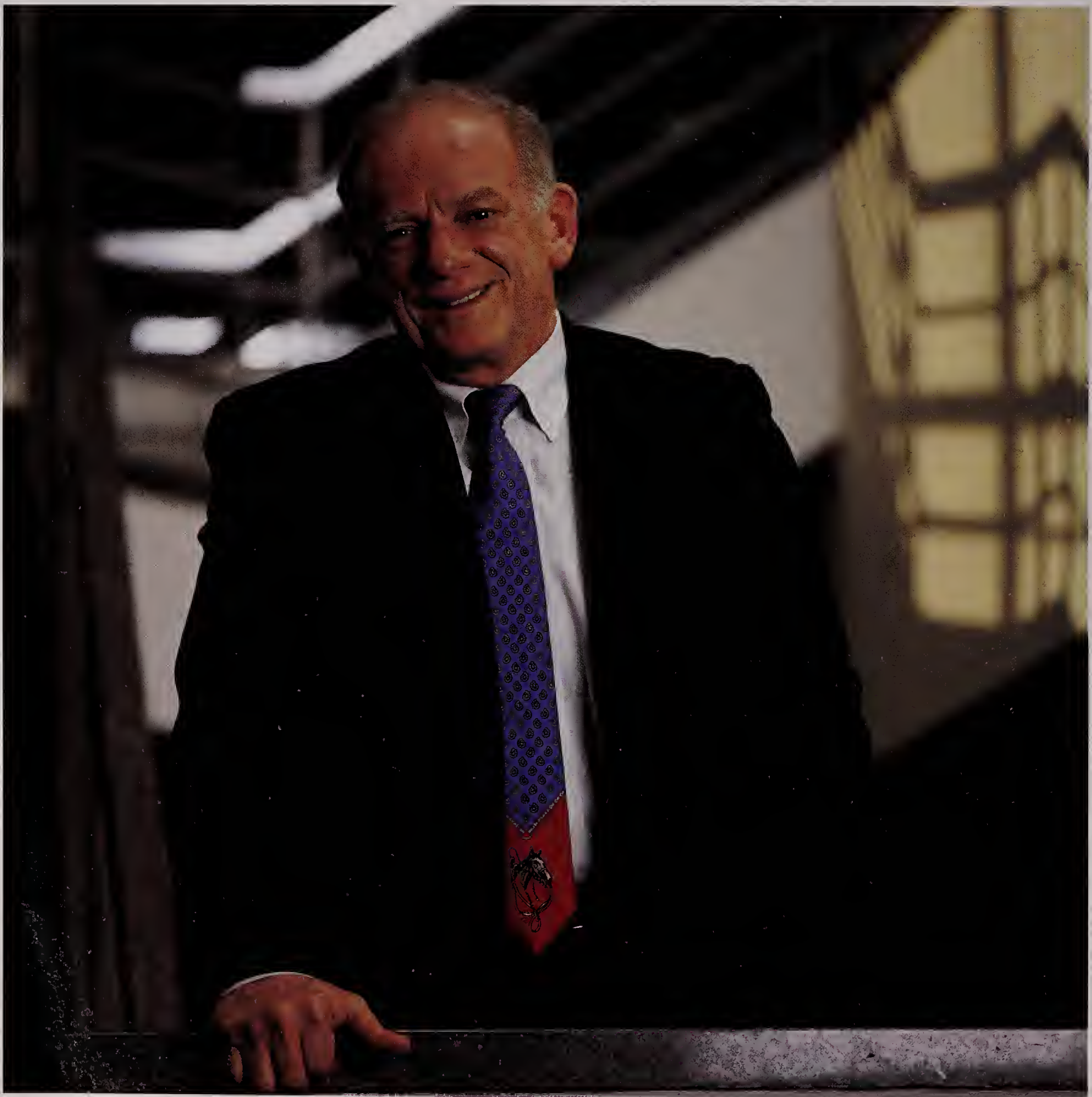

PHOTO BY NEIL MACDONALD

way to negative acceptance—"the yes-but syndrome," Smith explained. Then comes coexistence, in which people do what is required, but only half-heartedly. "You must be prepared to manage each stage [and] let [the stages] run their course," Smith advised. Eventually, people will accept the new practices.

People don't resist new technology, Hunt said; they resist the effect that new technology will have on their own lives. A management that provides ample training in the new skills will do much to allay fears of inadequacy and job loss. The most important management technique of all, though, is keeping communication lines open and creating an atmosphere in which people can voice their objections—which are, underneath it all, expressions of fear.

One mechanism for bringing resistance to the surface is to form a committee representing every affected group. Steve Hicks, manager of IS at Boehringer Mannheim Biochemicals Products Division in Indianapolis, is overseeing an effort to move applications off the mainframe onto minicomputers. He is being aided by a nine-member, cross-functional strategic-planning committee. When the conversion is complete, he hopes to reconstitute the committee into an ongoing user council.

Cooperation has been better than Hicks anticipated. "We set up the strategic-planning committee with certain goals and responsibilities, and [it] took on a life of [its] own," he said. "The [members] wanted the ownership and the involvement, and they got it. We had some resistance, but the team addresses those problems and eliminates them."

At USAA Information Services, the IS division of San Antonio-based insurer USAA, Ronald J. Kuznicki, manager of the automated systems environment effort, confronts the issue of discipline versus creativity head-on. "People say, 'I'll just be a robot. You're reducing my creativity,' " Kuznicki said. "I tell them, 'We want you to be creative in the business solution that you produce, not in the process by which you get to those solutions.' I remind them that aeronautical engineers live within the laws of physics, but they are very creative in the solutions they provide."

For change to work its way through the IS organization, sponsorship by a senior executive who has the purchasing power and ability to commit resources is essential. The sponsor must also have "the ability and willingness to exercise consequence management to get the job done," Hunt said. Put bluntly, the executive sponsor must be prepared to dismiss anyone who absolutely refuses to change.

A crucial precursor to successful change is the creation of a culture that rewards the desired new behavior.

1991 CIO SOFTWARE SURVEY

Pathways to a Better Development Process

Figures indicate average ratings of the helpfulness of various approaches in creating systems that have business value, on a scale of 1 through 5, with 1 being "not helpful" and 5 being "extremely helpful."

DEVELOPMENT APPROACH	DEGREE OF HELPFULNESS
Involving end users in the system planning process	4.65
Encouraging the creation of personal relationships between developers and end users	4.45
Involving IS in business strategic planning	4.02
Educating developers about the overall nature of the business	4.02
Educating developers about specific business processes	4.00
Involving end users in prototyping	3.89
Creating joint-application-design teams or sessions	3.80
Involving end users in establishing an information architecture	3.20
Training end users to develop their systems	2.85
Dispersing development groups in business units	2.70
Having developers report directly to business unit management rather than central IS management	2.38

Perhaps not surprisingly, the approaches that generated the least enthusiasm among CIOs were the ones that most explicitly shifted software development authority or initiative from IS to end users.

To Comdisco's Smith, the commitment of the senior vice president who filled the sponsor's role was a key ingredient in the success of the information systems group's project-management implementation. "He sat in a project-management workshop for three full days, 100 percent of the time," Smith said. "He was there on time. When we broke for lunch he was back on time. [He] basically left his stripes at the door and participated just like anyone else in the class."

"Change agents have to be committed to the change themselves. If they are trying to sell something they are not committed to, it won't work." *–James W. Hunt*

Another vital ingredient is a change agent, identified and publicly supported by the executive sponsor. According to Hunt, the change agent is closer in rank to those most directly affected by the proposed change and should be someone "who has credibility among peers and colleagues [and] who understands that resistance to change is a frame-of-reference issue; . . . you have to get inside other people's frame of reference to understand why they resist." The change agent must also be a skilled communicator, able to tailor his or her message to a variety of groups. "Above all," Hunt said, "[change agents] have to be committed to the change themselves. If they are trying to sell something they are not committed to, it won't work."

One such change agent is Margaret Tomczak, unit director in the Management Services Division of the Eastman Kodak Co., in Rochester, N.Y. Tapped by her management to lead the organization into a complete software engineering practice, Tomczak never considered the possibility that she might fail. "I'm an optimist," she explained. "I get so excited about the possibilities that I don't even think about failing. I'm more of a planner than a worrier. I don't worry; I just keep going."

Failure may not be part of the change agent's plans, but management should address head-on the possibility that mistakes will be made. "If we don't make mistakes, we're not trying hard enough," Smith remarked.

STEVE HICKS *used a committee to help battle resistance.*

Moreover, said Orr, "it turns out there is a high correlation in general between failure and learning." Most people remember the time in their careers when they learned the most as the time they also made the most mistakes. Society recognizes this by setting up mechanisms to let people it thinks of as being in training mode—children, for example—fail gracefully.

"We start them off on small things," Orr explained. "We watch over them, give them things to do where they can't kill themselves or us, and when they make a mistake, we give them a pat on the back and tell them they're really doing very well."

At some point, Orr continued, "the world says, 'OK, now you're trained.' From then on, everything conspires to make us less and less capable of learning and changing." The organization that really seeks change will create a culture that rewards experimentation and learning. Those that don't must prepare to fail. CIO

Mickey Williamson heads the Qwerty Group and edits the newsletter CASE Strategies.

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More than Meets the Eye

Graphical user interfaces make basic operations easy in a world where everyone uses computers but few know how they work

BY PETER G.W. KEEN

People of all ages, educational backgrounds and skill levels routinely use computers in the same way they operate automobiles. Even the least mechanically inclined driver can roll effortlessly down the highway without a second thought for the nitty-gritty details that make the automobile work. Similarly, computer users go through the procedures for accessing their machines' services with no real knowledge of the operating system. They can do this because the software interface hides the "real" system, providing users with a window into services and a protocol for managing them. To the majority of end users, the interface is the system.

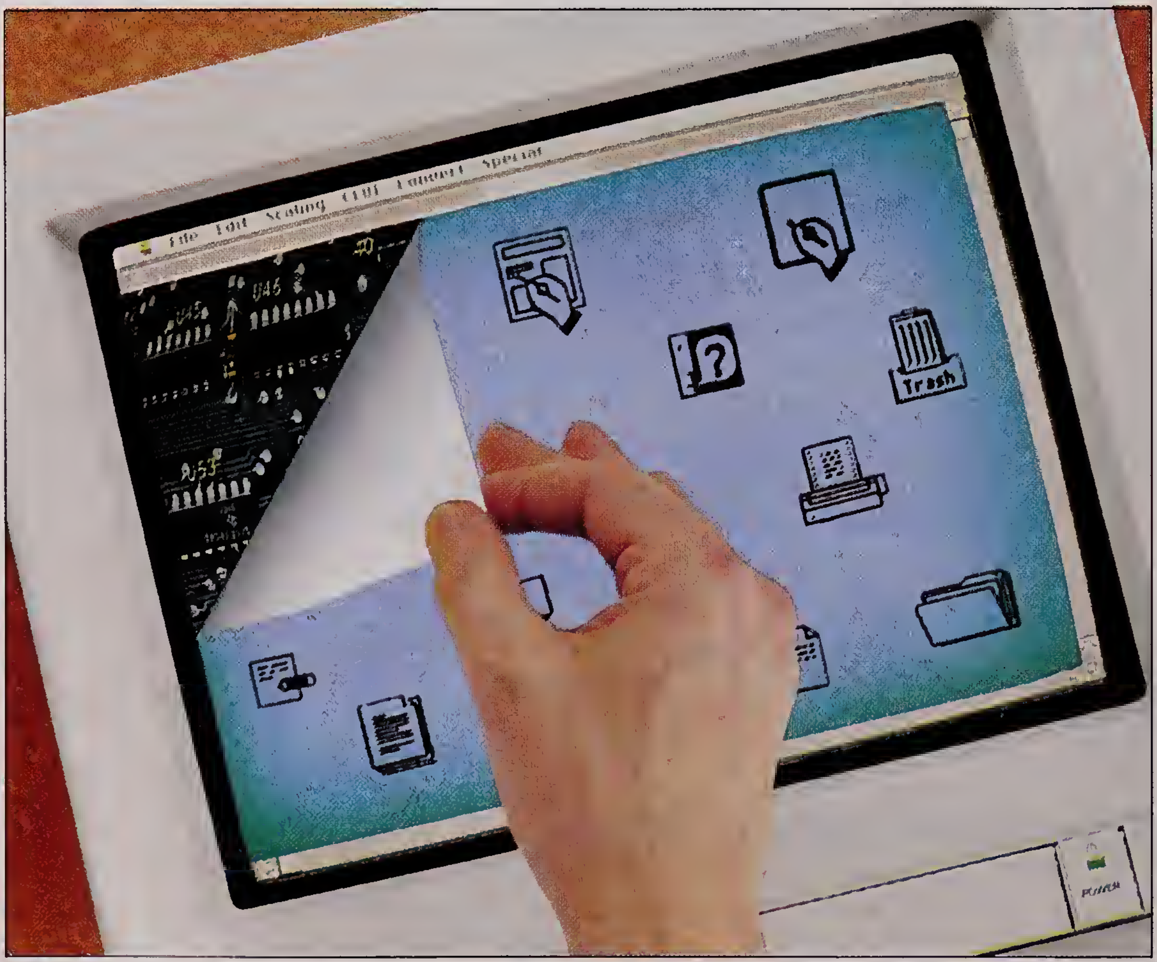
The same facilities can be made to look very different, depending on the interface. The most obvious instance of such an interface is Microsoft Windows, which "reinvents" DOS services. The technical building blocks remain the same, but to a user, the interface makes this a "new" system.

The software interfaces used in such common business transaction systems as automated teller machines and airline reservation and order entry systems come out of the tradition of computer programming and are an extension of the line-oriented teletype. They generally use menus or sequential commands and special words that invoke services.

Graphical user interfaces (GUIs) make that tradition look increasingly like an evolutionary dead-end. The computing world is converging rapidly on a set of near-standards for interactions between people and computers. Like the symbols representing controls in a car, there is some variation among these, but in general a few conventions (icons, clicks on a mouse, pull-down menus) allow easy entry into new systems and services.

Graphical interfaces now dominate everything from low-end Macintoshes to Windows to OS/2 Presentation Manager and Hewlett-Packard's New Wave. GUIs are becoming integral to spreadsheets (in Lotus 1-2-3 3.1 and Borland's Quattro Pro 2.0, for example), word processing, CASE and application development.

These are mainly the tools of end users working at personal computers. GUIs have not yet permeated transaction processing, electronic mail or database access. Structured Query Language (SQL) remains in the tradition of line-oriented teletypes, though that is changing as GUIs are added to the SQL interface. Transaction processing systems evolved without the high-resolution displays, multi-MIPS workstation capability and application development philosophy of object-oriented programming and client/server computing that have facilitated the move to-



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ward GUIs. Those technologies are now in place and will continue to provide more and more capability at a lower and lower price.

With the IBM RS/6000, Sun SPARCstation and DEC 5000 family offering 20 to 30 MIPS at $500 to $700 per MIPS, the 100-MIPS workstation will be ready for everyday use well before 1995. Screen quality and channel speeds are making full-motion video and CD-quality sound today's neat idea and tomorrow's commonplace. Three-dimensional graphics are available at the high end and will ride down the silicon price curve as fast as users drive demand. Image processing is among the most urgent concerns for business applications because it provides huge savings and promises to end the tyranny of documents. Only full voice recognition is still in the labs, with no guarantee that it will be in general use before the end of the 1990s.

In the multitude of interfaces made possible by these developments, GUIs may have come to represent a de facto universal convention. But the real issue for CIOs is the role of GUIs as part of a coherent organizational philosophy for interfaces in a world where everyone will be a user. GUIs are the system: What should that system accomplish?

Users should experience a minimum of disruption, filtering or translation between their work and the way they communicate with the system. GUIs are well-suited to many routine office tasks because the language they use corresponds naturally with the objects, activities and vocabulary of the work process. Thus, there is a direct mind-to-fingers link between the thought, "I want to start editing my report. Pick up the article and insert this diagram," and the window (the word-processing domain), the icons (paper and diagram) and movement of an icon (the process "insert") of the GUI.

There is some danger, however, that user-friendliness may come to be viewed as a requirement rather than a benefit. Many powerful analytic techniques in management science (simulation techniques, probabilistic analyses, optimization methods, statistical and forecasting methods), have not been widely adopted in the personal-computing world, possibly because, while useful, they are not easily used. In today's marketplace, where user-friendliness is at a premium, techniques that do not fit easily with a GUI mode of person-computer interaction do not get picked up by leading software developers, to the users' detriment.

If firms are to bet the future of their systems development on GUIs—which is a practical option—they need to look at their work methods and ask whether the GUI and related object-oriented-programming approach are truly intuitive across the main processes of the organization. Behind the development of GUIs must lie a new style of work analysis.

The system should also be easy to learn. No one who has worked with a GUI after wrestling with DOS can doubt that it shortens the learning curve immensely. A GUI can't make all new software services fast and simple to learn. But then, it really shouldn't; when complex techniques are made too simple, the risk of misuse increases.

That said, GUIs can only become more and more commonplace in business transaction processing systems, for three obvious and worrisome reasons: a shortage of adequately educated new staff, the increasingly complex functions and options in everyday computer-mediated activities, and the impossibility of providing enough ongoing training to keep up with the supply of new systems and uses of systems.

Examples abound:

One hotel chain, which will be able to hire only two qualified entry-level workers for every three jobs in the next five years, plans to leverage the people it has with information technology.

A state government examined the possibility of renewing drivers' licenses through bank ATMs but deemed the system impractical when it found that a plurality of its citizens did not have sufficient English-language skills to decipher ATM instructions.

A bank seriously considered putting all major systems development on hold for two years while it conducted a massive education program designed to familiarize its staff with the tricky details of its numerous new products and workstation-based systems.

These examples highlight the importance of moving users up the learning curve quickly. To achieve this, a common or at least near-standard interface is vital. It will certainly be GUI-flavored, since the only other choice is the videotex-type menu, which is slow, irritating and inflexible—unacceptable for just-in-time business transactions.

The real issue for CIOs is the role of GUIs as part of a coherent organizational philosophy for interfaces in a world where everyone will be a user.

An interface should also provide a high tolerance for mistakes. When a simple interface hides a complex system, it must trap and remedy the consequences of mistakes. An increasing number of users are computer-fluent but not computer-literate: They know how to drive and make decisions about transportation without being car mechanics. Unfortunately, users dependent on the simplicity of GUIs may be less able to cope with computer breakdown than DOS users, who have had to develop certain survival skills in order to diagnose and respond to problems.

Most GUIs are fairly tolerant of mistakes, but mainly in a stand-alone environment. Today's stand-alone personal computer is almost inevitably tomorrow's networked workstation in a client/server context. The underlying complexity of technical

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operations will be awesome, particularly in terms of end-to-end network management. Interfaces designed to help people do their work comfortably and smoothly must also help them handle breakdowns comfortably and smoothly. Are GUIs, which are well-suited to the work language of many business activities, equally suited to the work language of problem diagnosis?

Another requirement for GUIs is that they should enable the system to respond quickly. GUIs require a lot of processing power. The simple movement of a mouse onto an icon can generate a mass of client/server activity, screen management, communications and multi-task management. Until recently, some felt that the user-friendliness of the Macintosh and the ease with which users learned to operate it were outweighed by its slowness. Similarly, adding Windows to a DOS machine requires a significant increase in power and capacity.

Online business transactions, such as hotel check-in, ATM transactions and customer-service operations, demand response times far shorter than has been practical for GUIs until recently, and workstations far more powerful than was affordable. But the businesses that are moving to just-in-time everything—ordering, distribution, management alerting, payments and scheduling—recognize the need to pay the price. They are investing in OS/2 for their main transaction systems and eyeing high-end UNIX workstations for access to services.

There is plenty of computer power coming onto the market, and there's no reason to doubt that GUI-based systems will be able to provide the speed of response necessary for checking in the frustrated business hordes at Kennedy Airport late on a Friday afternoon. But harnessing this power will not be cheap, despite its rapid improvements in price-performance, because the demand for power will continue to increase. The Gartner Group Inc., a market-research firm in Stamford, Conn., calculates that over 20 MIPS of workstation processing power will be needed to manage the interface for such "simple" operations as retail bank-teller activities.

One tends to think of "power users" as those driving UNIX CAD/CAM Rambomobiles. The demand for the qualities listed above means that the real power users will be the ones running workstations where most of the system's resources are devoted to managing the interface for them so they can concentrate on the application itself.

Over the past 10 years, business has been creating its own laboratory for testing the best methods of creating computer perestroika. Personal computers, help desks, office technology, DOS, the Mac, UNIX, client/server, CD-ROM, cooperative processing, electronic mail, SQL—all are part of a rich and still-evolving mixture. A few clear principles are emerging from this informal "testing." One is that GUIs have won the consumer's vote. Another is that the client/server model, however vaguely defined, represents the mainstream direction of organizational computing and communications.

> *GUIs are well-suited to many routine office tasks because the language they use corresponds naturally with the objects, activities and vocabulary of the work process.*

Another conclusion that has emerged from the business lab is that object-oriented thinking will greatly affect the evolution of both GUIs and client/server. In the world of cooperative processing, links between objects will be handled within applications and will open up many new cross-functional business services. Applications, databases, videos, photographs, transactions and even people can be represented in a work language. The natural correspondence of the language to objects, of objects to icons, and of icons to object-oriented programming provides real hope that breakthroughs in software productivity, quality, usefulness, usability and speed of development will enable it to catch up with the other elements of the organizational technology base.

But CIOs cannot fully exploit these developments until they have determined their goals for interfacing people with computing and communications services. Reducing GUIs to easy-to-use screens or a Windows versus OS/2 trade-off means missing an opportunity.

Users can take what they have learned from everyday use of GUIs and extend that to specialized environments across all aspects of the organization. They can exploit voice recognition and response as part of object-oriented thinking that, while not literally graphical, still resembles the GUI in strategy. They can also be more inventive in the icons they establish. For example, an icon could be designated to initiate contact with the appropriate person in case of breakdown ("Send an immediate phone message to John Wilson").

Computer games have demonstrated that icons need not be literal representations of the physical reality. Every CIO interested in what is state-of-the-art in GUIs should buy a Nintendo Game Boy (called an executive handheld computer in the IS budget). SuperMario Land, apart from being addictive, shows how a richly complex application can be imaginatively designed and implemented. Flowers, coins, "chibibos" and "bunbuns" do not correspond to anything "real" but are signs that establish a game language that functions like a work language.

The interface truly is the system. Much of the success of IS in the 1990s depends on how it establishes the general interface for general work. GUIs are the starting point.

Peter G.W. Keen is executive director of the International Center for Information Technologies in Washington, and a professor at Fordham University. His new book, Shaping the Future, *has just been published by the Harvard Business School Press.*

On April 26, an awesome fight will end in a technical knockout.

Okay, so it won't exactly be Tyson-Holyfield, but The Computer Museum's 3rd Annual Computer Bowl still promises to be one of the most exciting quiz games you'll ever witness. Join us ringside for round after round of mind-boggling action as the finest minds in the East and West go head to head. See who ends up on the ropes first. See who beats whom to the punch. But, most important, see who's left standing when all is said and done. The place: The San Jose Convention Center, San Jose, CA. With live broadcast via satellite to The Computer Museum in Boston. Don King, eat your heart out.

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The Computer Bowl is a project to benefit the educational programs of The Computer Museum, 300 Congress Street, Boston, MA 02210.

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The Computer Bowl

An Executive Conference Focusing on the Complexities of the Future and How to Prepare For Them

The Society for Information Management
1991 Institutional Member Conference
April 10-12
Westin La Paloma
Tucson, Arizona

Looking into the future is an exciting, yet apprehensive process. With accelerating change in the workplace, environment and political arenas, this process becomes even more complex. The organizations that chart a clear path today will ultimately witness resounding success tomorrow.

SIM's 1991 Institutional Member Conference will help you plan a course for future success by presenting a view of business and the marketplace in the post-1995 time frame.

Distinguished leaders in business and the IS industry will provide the building blocks for your organization, drawing on their extensive experiences and insights in business management and organizational issues.

Seven speakers will guide attendees through six critical building blocks for the future. They include:

The Future: **John Elkins,** President, The Naisbitt Group.

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THEORY AND PRACTICE

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The SIM Institutional Member Conference is a sound investment for your future. Insightful presentations, peer-to-peer discussions and most importantly, interaction with IS executives from around the world offer invaluable professional development experience.

For more information on the 1991 SIM Institutional Member Conference, contact SIM Headquarters, 312/644-6610.

"Recognizing the Coupling of Information Technology with Business Strategy to Achieve Corporate Objectives."

THE SOCIETY FOR
INFORMATION MANAGEMENT
ANNUAL AWARD FOR
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LEADERSHIP

Call for Nominations

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As a nominator, you will play a crucial role in identifying and advocating the case of the two nominee executive partners. And, because the recipients of the award are senior executives, it may be necessary to nominate yourself.

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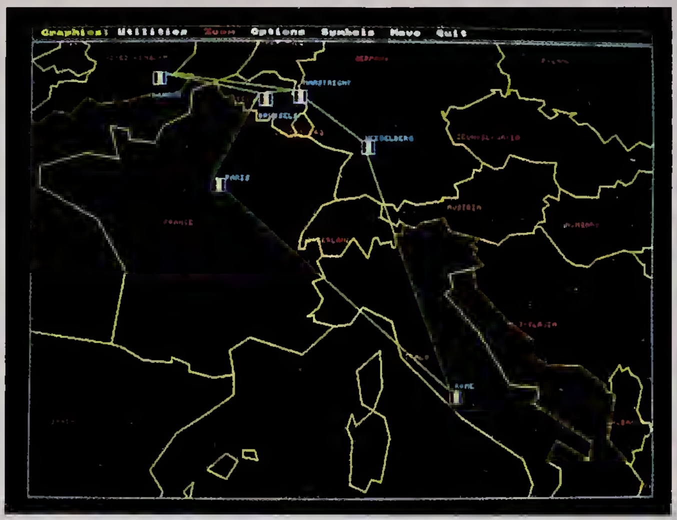
FYI

Comparison Shopping

"Worldwide communication is becoming the critical link in a company's ability to do business successfully on the international playing field," according to Howard Frank, chairman of Network Management Inc. (NMI). "International networks are expensive and [difficult] to design."

Consequently, NMI has added a new product to its line of Modular Interactive Network Designers called I-MIND, which can automatically map out the most economical routes for global data networks covering up to 16,000 locations. Users can measure and compare cost and performance trade-offs by quickly creating different configurations.

Pricing information is drawn from I-MIND's library, updated through online support services, of over 500 current telco rates. The system's graphics capabilities include global and national mapping features as well as plotter support. I-MIND is available for a broad range of platforms and costs $24,000 for a single copy, with bulk discounts available. For more information, call 800 765-4622.



No Product Is an Island

Stand-alone computers are being networked to extinction, but how about stand-alone desk lamps or stoves or heating systems? They may be on the endangered list too, since Echelon Corp. of Palo Alto, Calif., is developing a way to network groups of traditionally non-communicating devices in local operating networks (LONs).

LONs rely on computerized microchips—called Neuron Chips—that can be installed in products as varied as light bulbs and factory robots. These chips can sense movement and temperature, count, tell time, manage switches and communicate with each other via any communications medium, including regular electrical wiring. They can be used to create smart environments in homes, businesses or vehicles. For example, a factory LON could monitor a product moving down a conveyor belt, update inventory and alert security if the product is sidetracked or disappears.

The LONBUILDER Starter kit, the $14,965 development workbench portion of Echelon's LONWORKS development suite, will begin shipping in April. Motorola and Toshiba will produce Echelon's Neuron Chips. Echelon plans a series of LONWORKS technical seminars this year. For more information, contact the company at 415 855-7400.

All Gussied Up

Users of laptop, notebook and other portable computers can perform beauty makeovers on their dowdy old displays with a new program from Personics Corp. of Maynard, Mass. Laptop Ultra Vision was designed to improve the legibility and appearance of LCD and gas-plasma displays through a variety of enhancements, including compressed text modes, high-resolution fonts, and color-shading and cursor-shape controls.

Longer screen displays (25, 34, 50 and 60 lines of text on flat-panel VGA; 25 and 43 lines on flat-panel EGA) allow users to see more information with less scrolling. The utility also enlarges standard 25-line VGA text for extra clarity.

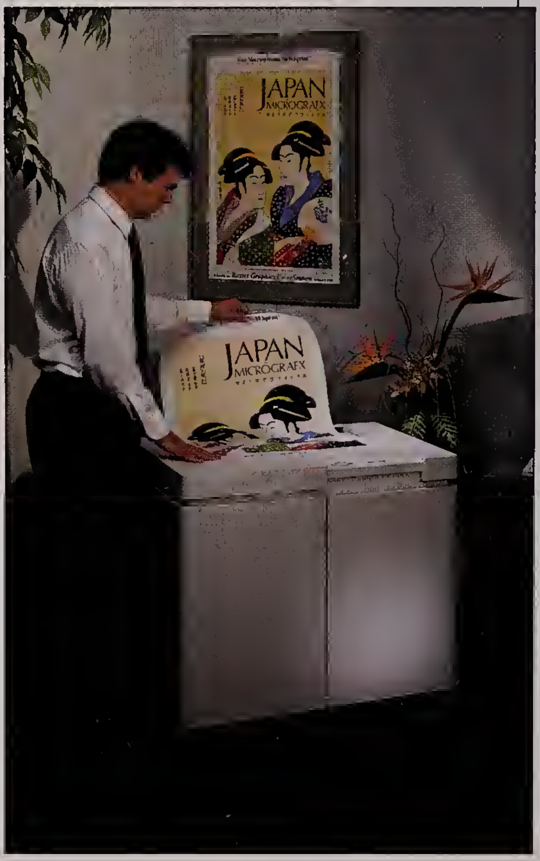
Ultra Vision comes with a library of 20 high-resolution screen fonts, including Roman, Sans-serif and Courier, and novelty fonts like Broadway and Old English. A Palette Control adjusts the gray shades when software designed for color monitors is in use. And users can replace the standard underline cursor with a tall blinking box cursor.

Suggested retail price is $69.95. For more information call Personics at 508 897-1575.

Suitable for Framing

Sometimes your input is only as good as your output. The inability to quickly and inexpensively produce detailed hard copy is one drawback of sophisticated CAD systems. As a solution to this problem, RasterGraphics Inc. offers a new electrostatic plotter that can churn out high-resolution poster-sized images in minutes.

The ColorStation Model 424 is a full-color, large-format, laser-quality printer capable of producing 24- by 36-inch plots. The ColorStation can operate as a stand-alone unit or be networked with PCs, Sun workstations and Macintoshes; it is compatible with most popular application packages including 3-D rendering software. Features include a two-inch-per-second writing speed, automatic paper load, print and eject for cut-sheet output, standard 200 dpi resolution upgradeable to 400 dpi, 256 colors for line drawings and 16 million colors for rendering. At 240 pounds, the ColorStation is one-third the size and weight of conventional electrostatic plotters, according to the company. It has a base price of $27,900. For more information call 800 441-4788 or 408 738-7800.



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- *The Management Track* covers subjects like gaining competitive advantage, adopting object technology, leapfrogging technologies with OT, and migration planning.
- *The Technology Track* explores topics like needs assessment; evaluating languages, environments, and databases; and standards and user groups.
- *In-depth Applications Case Studies* give you a close-up look at the many companies who are running object-oriented commercial applications today—the successes, as well as the failures.

VISIT THE LEADERS OF OBJECT TECHNOLOGY.

In between you can stop by our exhibit hall and talk with companies like AT&T, Borland International, Digital Equipment Corp., Digitalk, Hewlett-Packard, Parc Place Systems, Servio Corp., Sun Microsystems, and more—the people who are shaking up the present and shaping the future of object technology.

WHO SHOULD ATTEND?

Chief information officers, IS managers, MIS/DP managers, technology planning managers, managers of systems development/architecture, programming supervisors, and software development managers. In short, anyone and everyone who wants to explore the potential of this rapidly growing technology should be in San Francisco June 3-7, 1991.

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JUNE 3-7
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EVENTS

Fourth Annual Computer Virus & Society Conference

World Trade Center, New York
March 14 & 15
DPMA Financial Industries Chapter, in cooperation with IEEE and ACM
800 835-2246, ext. 190

This conference has five major tracks: recovery, product demonstrations/evaluations, management, technical/research and CDP exam preparation. Topics include recent outbreaks, intruder prevention, detections and justice issues. Attendees receive the 800-page bound Proceedings. Registration fees: $275 for one day; $375 for two days.

The bound Proceedings are also available separately for $100 from the DPMA.

Bridges to the Future: Theory and Practice

Westin La Paloma Resort, Tucson, Ariz.
April 10-12
Society for Information Management
312 644-6610

This conference explores the state of information systems after 1995. Keynote presentations and the opportunity to tour Biosphere 2 are included. Registration fees: $950 for members; $2,950 for nonmembers.

Computer-Based Training Conference & Exposition

Marriot Rivercenter & Convention Center, San Antonio
April 7-10
Weingarten Publications Inc.
617 542-0146

This conference is designed for people who manage or develop computer-based systems. Topics such as CBT fundamentals, vendor-client relations, instructional strategies and testing are covered. Registration fees: $215-$735.

Information Industry Association Spring Conference '91

Stouffer Esmeralda Resort, Palm Springs, Calif.
May 19-21
Information Industry Association
202 639-8262

This conference explores new technologies and methods for adding value to information, examines risks and rewards of various information distribution options and discusses the nature of the customer-applications environment. Registration fees: $495-$995.

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Editorial, Advertising and Business Offices: 492 Old Connecticut Path, PO Box 9208, Framingham, Massachusetts 01701-9208–(508) 872-8200. **Postal Information:** CIO (ISSN 0894-9301) is published monthly by CIO Publishing Inc., 492 Old Connecticut Path, PO Box 9208, Framingham, Massachusetts 01701-9208. Second-class postage paid at Framingham, MA, and at additional mailing offices. **Reprints:**

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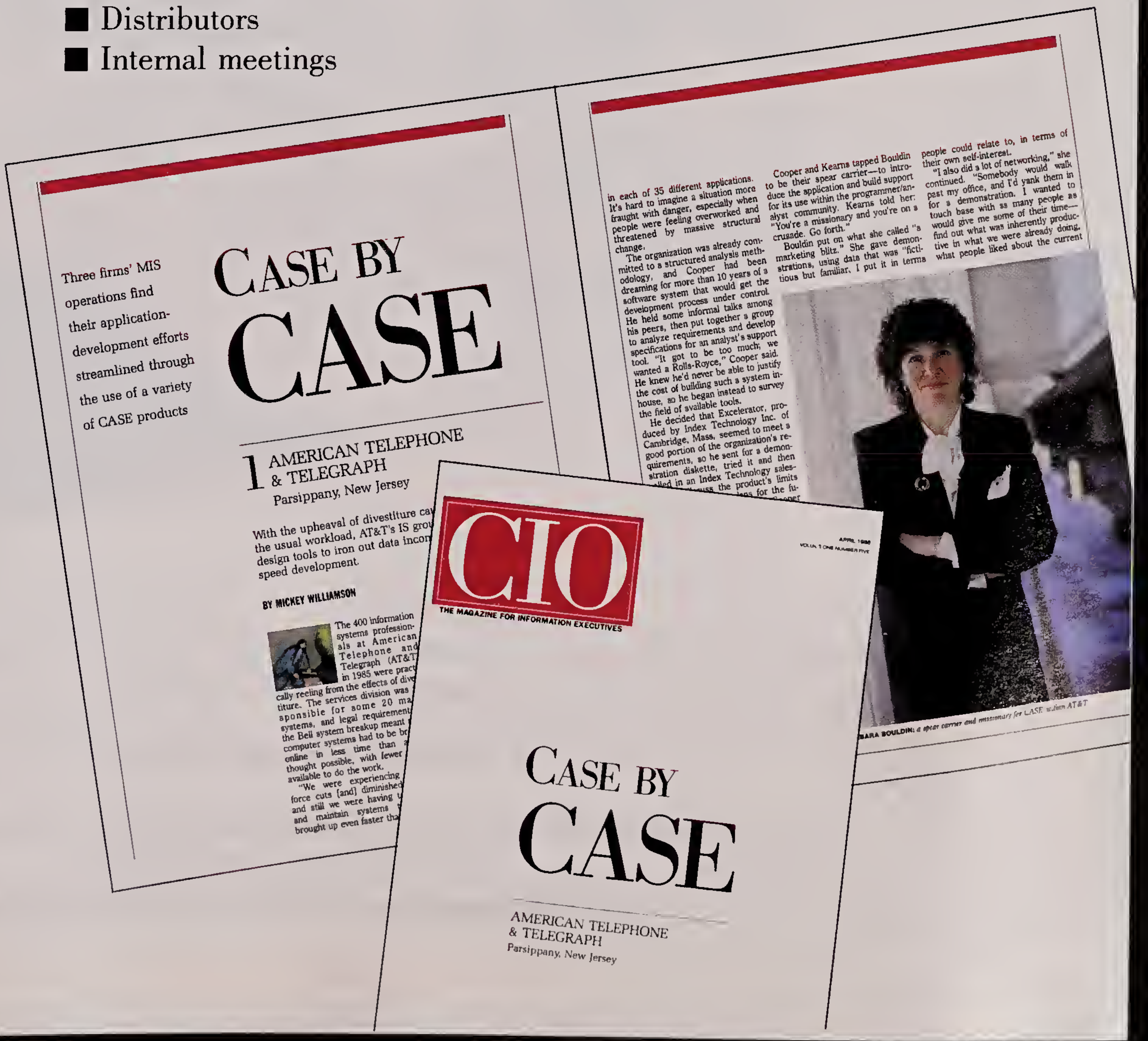

Three firms' MIS operations find their application-development efforts streamlined through the use of a variety of CASE products

CASE BY CASE

1 AMERICAN TELEPHONE & TELEGRAPH
Parsippany, New Jersey

BY MICKEY WILLIAMSON

CIO
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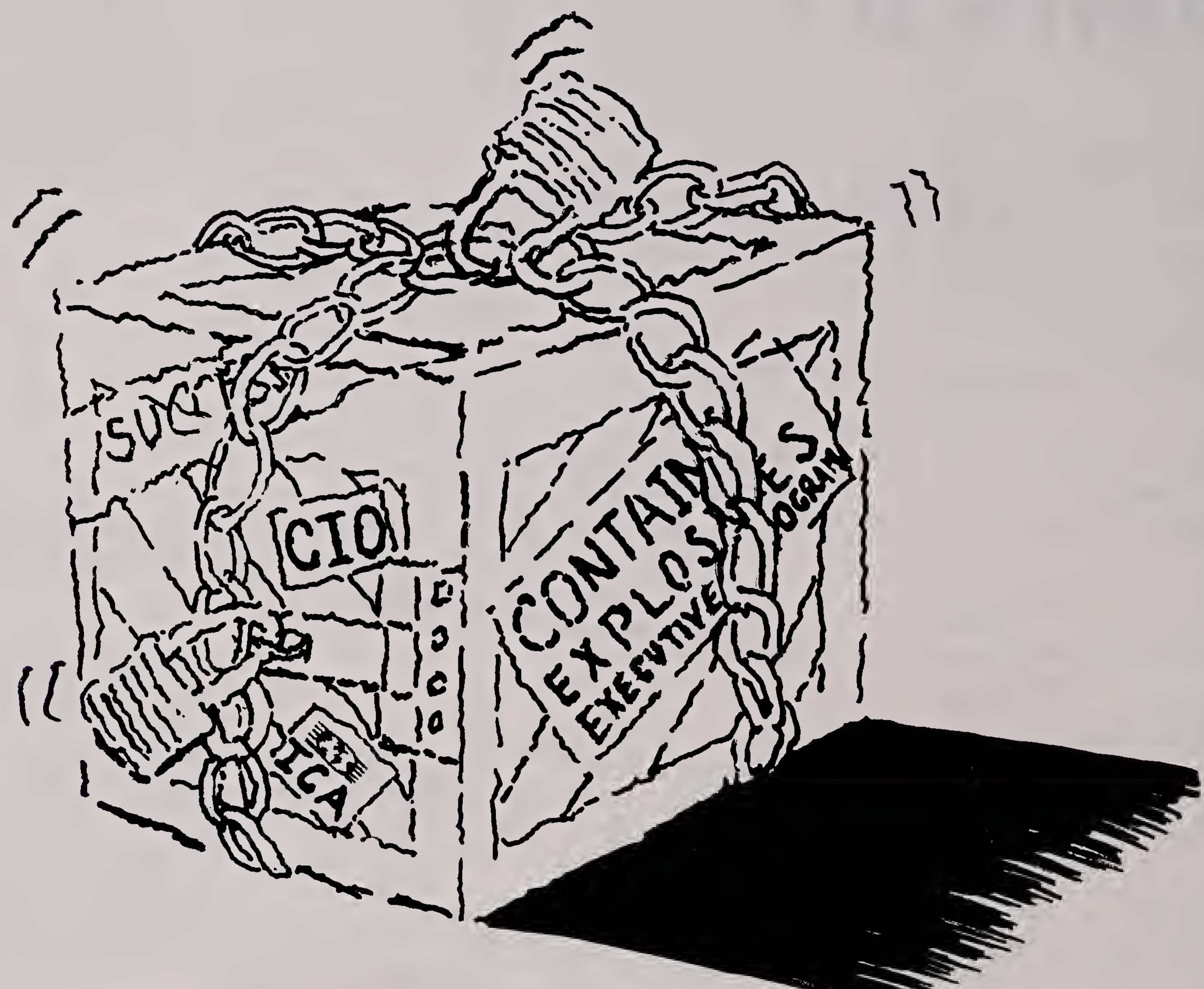
THIS BOX CONTAINS AN EXECUTIVE PROGRAM SO EXPLOSIVE IT HAS TO BE KEPT UNDER LOCK AND KEY!



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CONFERENCE CALL

QUESTION: *How do you measure user satisfaction?*

From surveys to audits to informal interviews, the metrics companies use to measure user satisfaction may mirror the complexity of their organizations.

Franklin D. Johnson
Director of information technology assessment & planning for the State of Connecticut in Hartford

“By the number of spears and darts. Generally we have a group of telecommunications managers that bring us back word of satisfaction among our telecom users. We are establishing an IS manager group that we hope will be able to do the same thing. In the meantime we have IS advisers who are conduits with our users in terms of complaints, comments and compliments.

“About a year ago we sent a survey to all of our users within the state. It covered more areas than just IT, such as personnel, human resources, purchasing, contract administration, etc. Surprisingly, it told us that we were pretty much on track. Of course, like in any organization, we did have a few people who were very dissatisfied. Any person in the state organization—in any of the 165 agencies, boards and commissions that use our services—can call any one of the responsible managers or the directors of IS services with any kind of complaint or compliment. If there is a complaint that hasn't been solved by the administrator, then it gets pushed up to the director's office, stopping short of the governor's office, and there a solution is worked out. If two people are butting heads, though, it does go to the governor's office.

“What we are initiating now is a business systems planning program that is going to put all IT managers in close contact with the office of information technology. The routes of communication will not be new, but they will be strengthened by providing review and technological input.”

Wallace R. Richardson
Manager of MIS for Inland Steel Industries Inc. in East Chicago, Ind.

“We have a couple of different mechanisms. One is a [user] survey for maintenance. When we do maintenance work, each analyst has to send a customer evaluation concerning quality (such as, was the work done to specifications), delivery (was it completed on time) and service (did the customer get what was wanted). These surveys go out every time we do something, and most are filled out and returned. At the end of each quarter we total them up and give an award to the group of analysts with the highest rate of satisfaction.

“We also do what I'd call a customer audit on an annual basis. This is a very detailed report covering 10 different areas—again based on quality, delivery and response time. Customers rate the entire information services department, including hardware installation, maintenance, training, problem-solving reports to our help desk, and computing services. It indicates how well they perceived us by uptime. This is a 12-page report, so it is very detailed, and customers frequently write in additional comments. Based on these, we have to improve anything that does not exceed expectations. Meeting expectations is not good enough.

“Throughout the year, we do have lines of communication open. We're open seven days a week, and we have a help desk that is open 24 hours a day.

“[To a certain extent] my paycheck is determined by customer satisfaction, so it's a real incentive to listen to our customers and be as helpful as possible. And to me, a customer is anyone that uses our systems—be it at Ford or Whirlpool or in our accounting department. We want both internal and external satisfaction to be high.”

Robert Page
Director of projects for Solon Automated Services in Philadelphia

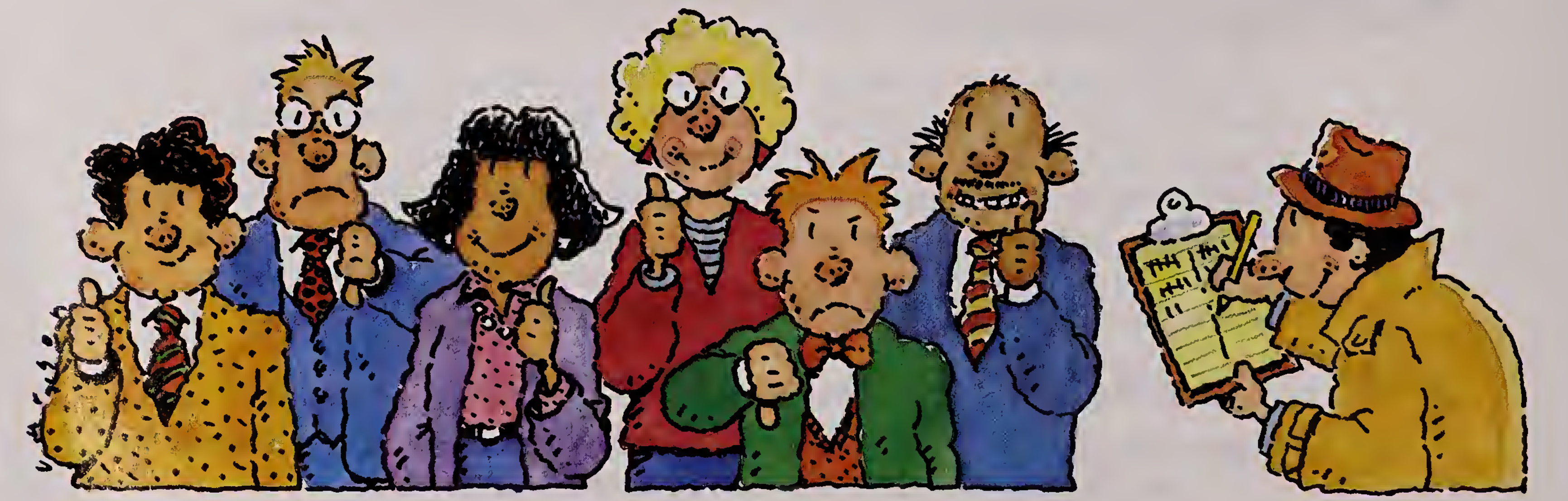
“We don't have anything formalized in place to measure end-user satisfaction, just feedback from our regional people and people here in headquarters. We're in the business of installing and managing coin-operated washers and dryers in multifamily housing units—apartment complexes, condominiums and universities.

“We drive IT more out of [our headquarters] than out of the regions. Our [13] regional sites are like data-collection areas, and we transfer information up into our host system every night.

“The regional people have inquiry access to the master file in the system here. Some areas will come in and ask us for information, while for others we just disseminate [information] out.

“We do have plans for more formalized feedback. We're looking at having some update capabilities in the regions. We only have one application—a collection-type application—so we're also looking at doing some fixed assets and general ledger information, and allowing them to inquiry into that too.”

Readers are invited to suggest Conference Call questions. Contact Senior Writer Meghan O'Leary at 800 343-4935, ext. 4733, or by fax at 508 872-0618.



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